The United States Arsenal at Frankford—III.

BY F. A. STANLEY.

The bullet jacket for the .30-caliber cartridge is an alloy of copper and nickel known as cupro-nickel; it is blanked out and drawn up and shaped by a series of operations whose sequence is indicated in the half-tone, Fig. 32. The stock is 0.036 thick (19 gage), and the disk punched out in the double-acting presses is about 1 inch diameter. After three successive draws, the surplus metal is trimmed off the mouth, and a final draw is then made, leaving the jacket still a little long, to allow for a final end-trimming to exact length. The upper row in Fig. 32 shows the work as it advances through the stages mentioned, and Fig. 33 illustrates a group of draw presses, with automatic feeding hoppers, for performing the drawing operations.

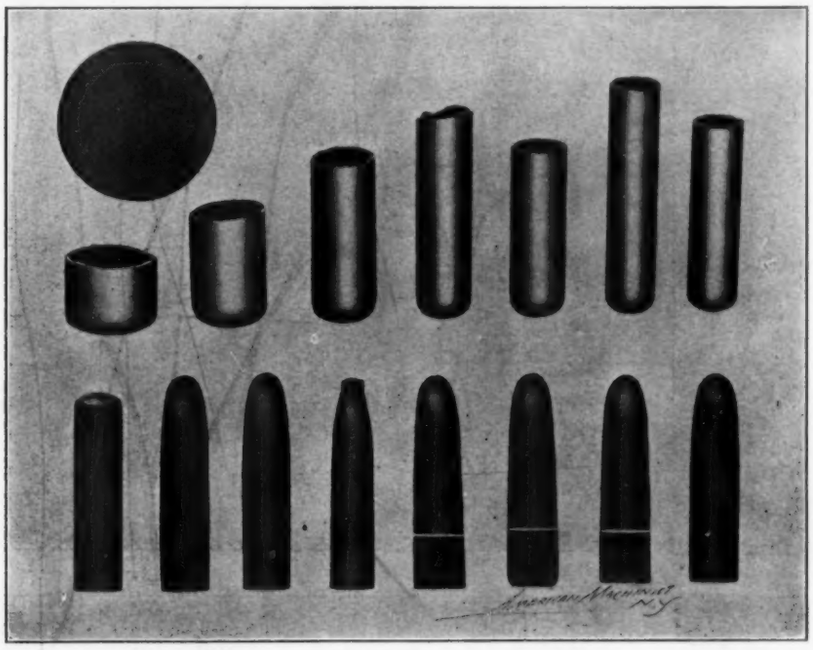

FIG. 32. SHOWING EVOLUTION OF NICKEL JACKET AND BULLET. THE SAMPLES CUT OPEN SHOW METHOD OF CRIMPING JACKET.

MOLDING AND ASSEMBLING BULLETS.

The bullets or lead and tin composition cores are molded in the lead shop, Fig. 34, which is equipped with seven oil furnaces with four lead pots to each furnace. The molds are long enough for sixteen slugs each, and one man will pour about 500 pounds of slugs per day. From the lead shop the slugs or cores are taken to the bullet-assembling machines, shown in the right-hand row in Fig. 35, and there the jackets—after being cleaned by tumbling—are shaped and provided with their lead centers. The lower row of samples in Fig. 32 shows the work accomplished by the assembling machines.

These presses require two operators each, and perform six operations on as many jackets (one on each jacket) simultaneously. Two dials rotating in a longitudinal plane carry the work under the punches, the dials being provided with a series of chambers near the periphery, and the bullet dial at one side overlapping the jacket dial, so that at this point the composition core can be forced out of its chamber in the upper dial and down into the jacket beneath. The dials have ratchet-and-pawl rotation, and at each return movement of the pawl the punches carried by the ram of the press perform their work. As the jacket dial brings the cupro-nickel case under the first punch, the point of the jacket is partly formed, and the next punch at the following stroke of the press completes the point. At the next movement the slug is forced down into the jacket, then the open end of the latter is crimped slightly, and the next punch completes the crimping operation; the last punch forces the now jacketed bullet down through a sizing die and out of the machine. In the resizing machine, shown to the left in the same view, the rear end of the bullet is tapered slightly, and following this operation a "0" is stamped on the flat end.

THE LOADING ROOM.

Fig. 36 presents a view in the bullet department, with a number of employees at work on paper bullets for blank cartridges. The doorway in the background leads into the loading room, and a view in this department is given in Fig. 37. There are thirteen loading machines in the room, and an operator is required for each.

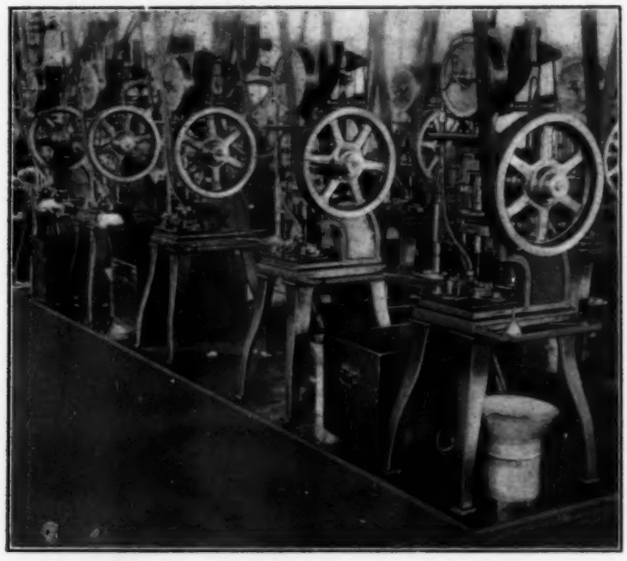

FIG. 33. BULLET-JACKET DRAW PRESSES.

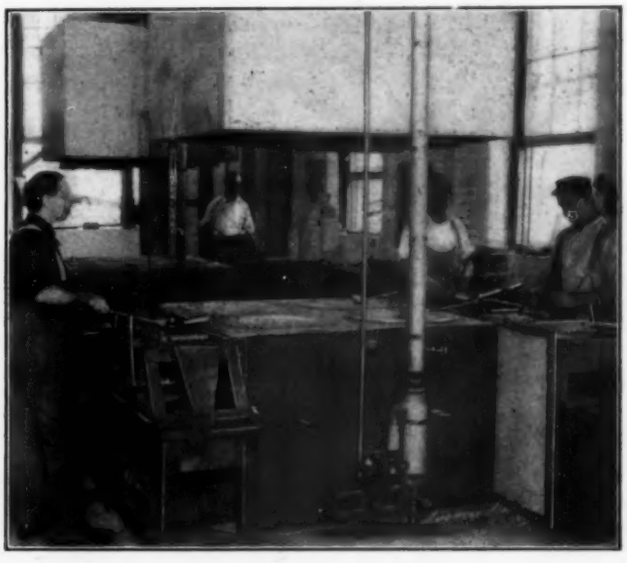

FIG. 34. VIEW IN LEAD SHOP.

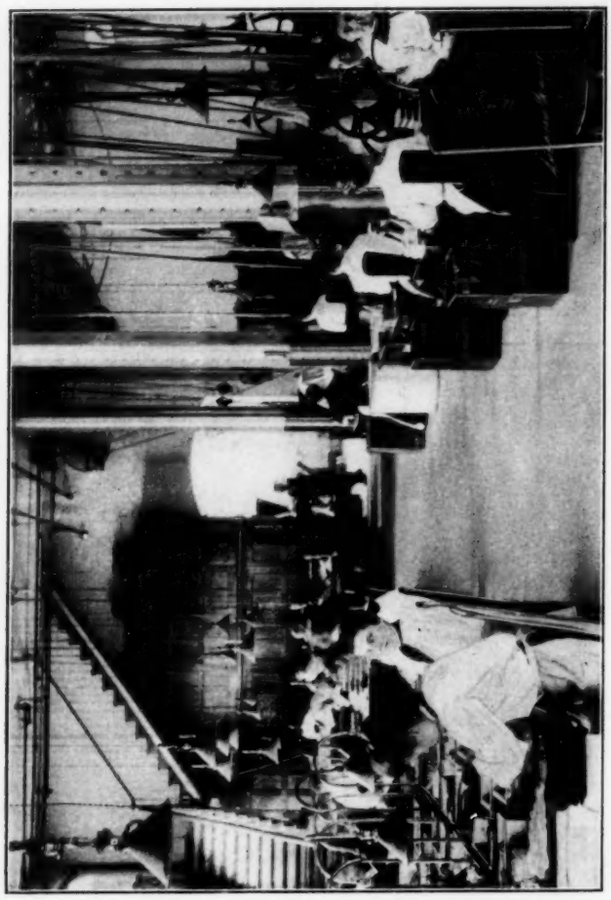

FIG. 36. FORMING AND INSPECTING PAPER BULLETS.

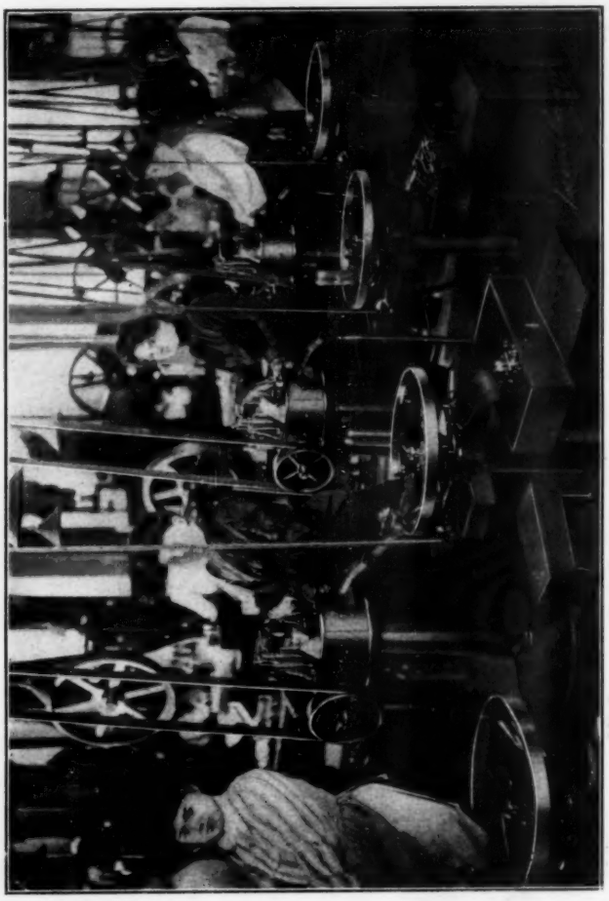

FIG. 38. GAGING AND WEIGHING MACHINES.

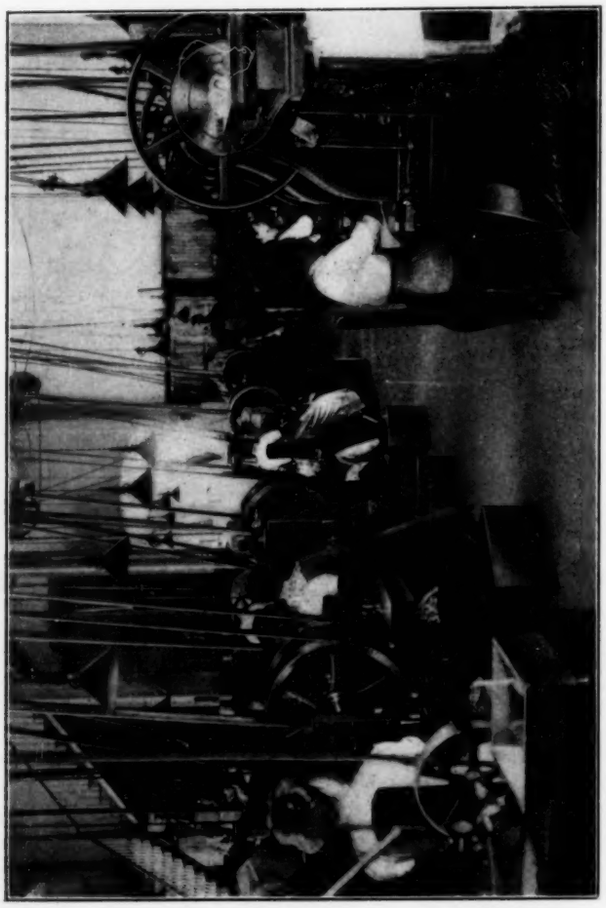

FIG. 35. ASSEMBLING AND RESIZING JACKETED BULLETS.

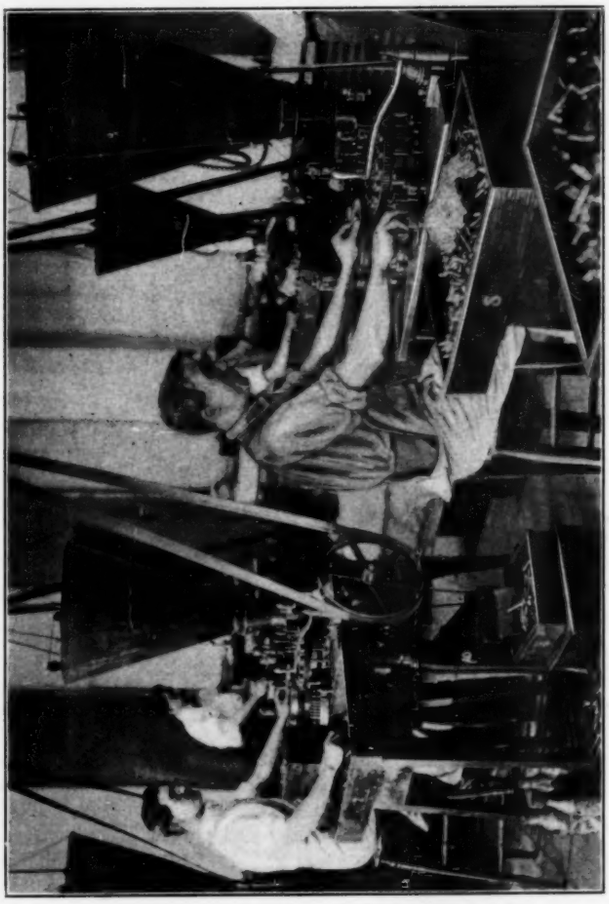

FIG. 37. LOADING MACHINES.

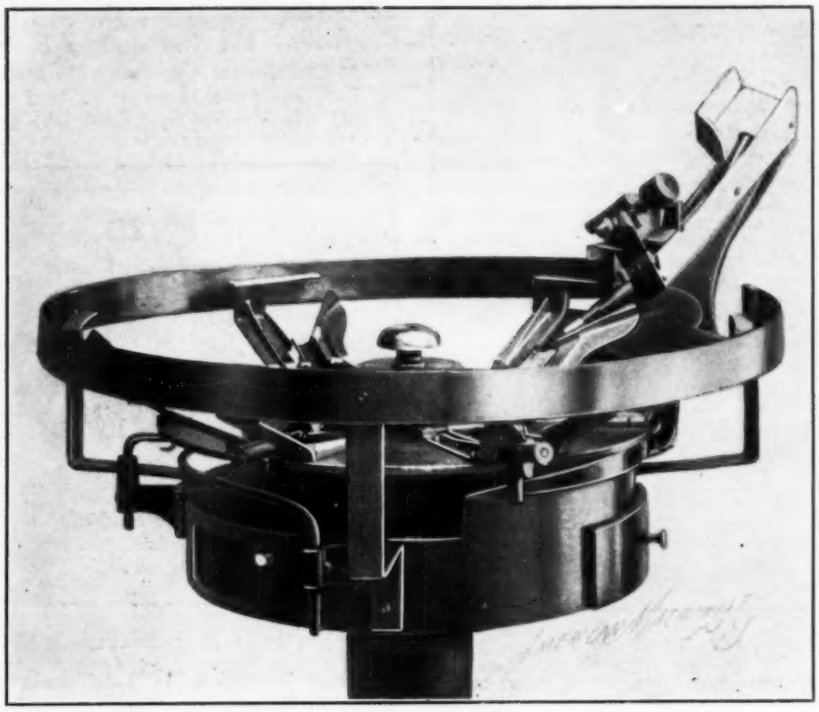

FIG. 39. WEIGHING ATTACHMENT FOR GAGING MACHINE.

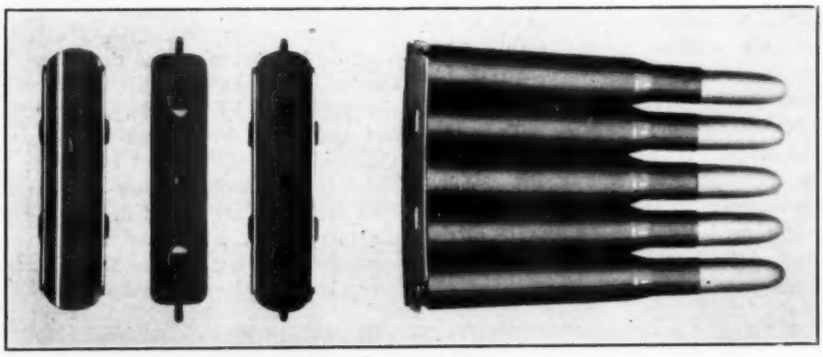

FIG. 40. THE CARTRIDGE CLIP.

The mechanism of the loaders consists essentially of two horizontal dials—one for shells and one for bullets—a powder magazine and charger, and a series of punches operated by a vertically reciprocating ram. The dial to the right is notched to receive the shells, which are led into the notches by a continuously rotating disk upon which they are placed, open end up, by the operator's right hand; the dial to the left, which is geared to the shell dial, is drilled out to receive the bullets, these being dropped, one in each chamber, by the left hand. The rotative movement is by pawl and ratchet, the dwell preceding each advance being sufficiently long to enable the powder charger and the series of punches to perform their operations.

The powder charger is a reciprocating slide containing a chamber to hold just the required amount of powder; the slide is moved to and fro through a guide under the magazine, and at each dwell of the shell dial it advances until its chamber is over the empty shell or case and deposits the charge therein, then recedes in its seat under the magazine for a fresh charge. A vibratory motion given the charger prevents the powder from lodging and insures the full charge being deposited each time. As the charged shell advances to the next position, a punch seats the powder and another punch connected with a bell gives warning if through any accident a case has passed the magazine without being properly charged. As the shell comes under the overlapping bullet dial, a punch forces the bullet down into place, and the loaded cartridge then passes out of the machine. Before loading the bullets are dipped in a lubricant of Japan wax and graphite, and the shells are thoroughly cleaned. Blank cartridges are loaded here as well as ball, and the capa-

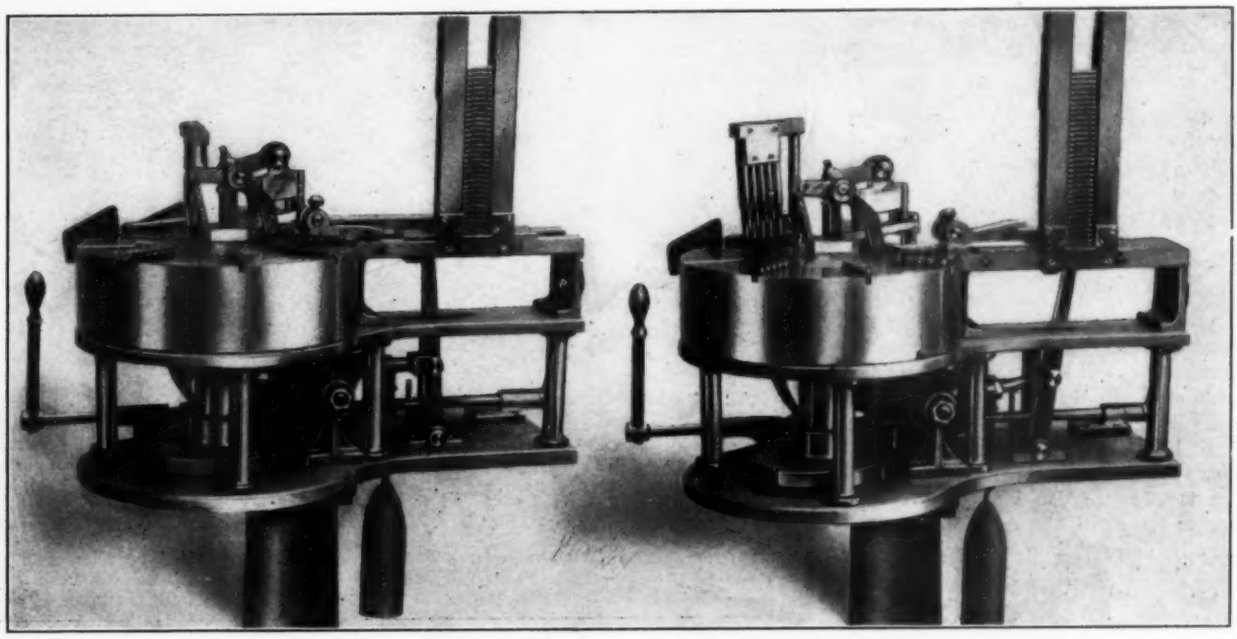

FIG. 41. MACHINE FOR ASSEMBLING CARTRIDGES IN CLIPS.

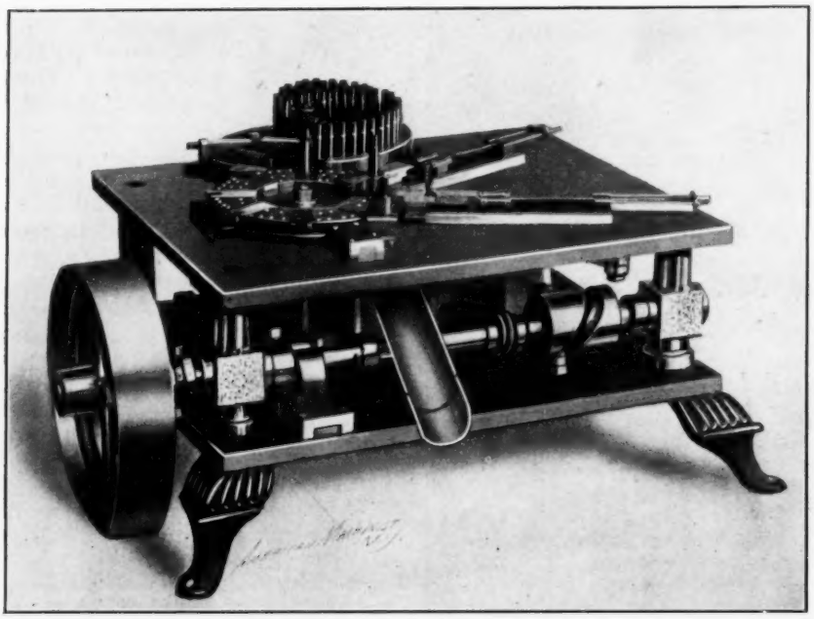

FIG. 42. CARTRIDGE-HEAD GAGING MACHINE.

city of each machine is about 16,500 per day of eight hours.

The sheet-steel, funnel-shaped magazine, while quite bulky in appearance, seldom contains more than 2 or 3 pounds of powder; it is made of the height indicated, to guard the operator from injury in case of explosion. The powder is actually held by a straight pasteboard tube, say, 2 inches diameter, with a flaring top, which extends to the wall of the metal funnel, and on the column of powder in this tube rests a metal ball attached to the end of a cord whose outer end, after passing over a sheave, is secured to a lighter ball, shown suspended at the side of the magazine. As the supply of powder lowers in the tube, the ball descends with it and the ball at the outside rises; thus the operator can gage the powder supply in the magazine and knows when to replenish it.

GAGING AND WEIGHING APPARATUS.

For gaging and weighing cartridges after loading, some ingenious machines are employed, a number of these being visible in Fig. 38. A girl sits at each machine and drops the cartridges, head up, into chambers in a rotating dial; if the cartridge is over length between shoulder and head, the machine is automatically stopped by a trip which is operated by the projecting cartridge head, and cannot be started again until the imperfect cartridge is removed. In the case of ammunition having flanged or rimmed cases, if the rim or head is too thick, the machine is stopped in the same way as if the shell were too long. Also if a head is too large or too small, the cartridge is automatically dropped into a special receptacle. As the work is ejected from this machine it slides down a trough into a weighing attachment, which is shown a little more clearly in Fig. 39.

In this device a series of metal carriers or balances large enough to receive a cartridge are located about a ring which revolves around a central post. Each carrier has a nicely adjusted balancing weight and as a cartridge slides down the chute into a carrier, if the cartridge is full weight the mechanism remains in balance until it has been indexed through a half-turn, when it is automatically tripped and the cartridge drops into a box. If for any reason a cartridge happens to be light weight, the balance weight lifts the carrier clear of the first tripping mechanism, but causes it to be engaged by a second trip, which ejects the underweight cartridge into another box. So sensitive is the mechanism that cartridges only 2½ grains light are automatically discovered and rejected. These special appliances, with the numerous inspections by hand, make it extremely unlikely that imperfect ammunition will get into the packing room.

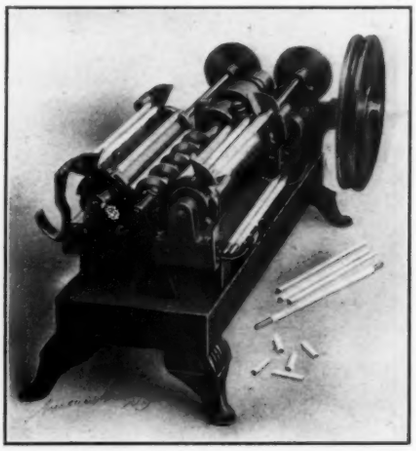

FIG. 44. PAPER TUBE CUTTER.

ASSEMBLING CARTRIDGES IN CLIPS.

After inspection the cartridges whether blank or ball, are placed in their clips, as shown in Fig. 40, and this operation is also performed by machinery. The clips and springs are first assembled by special machinery and then placed in the magazine of the machine shown in Fig. 41. Five cartridges are placed in each slit of the turret as it is indexed around, and upon their arriving opposite the magazine a clip is drawn forward and slid over the

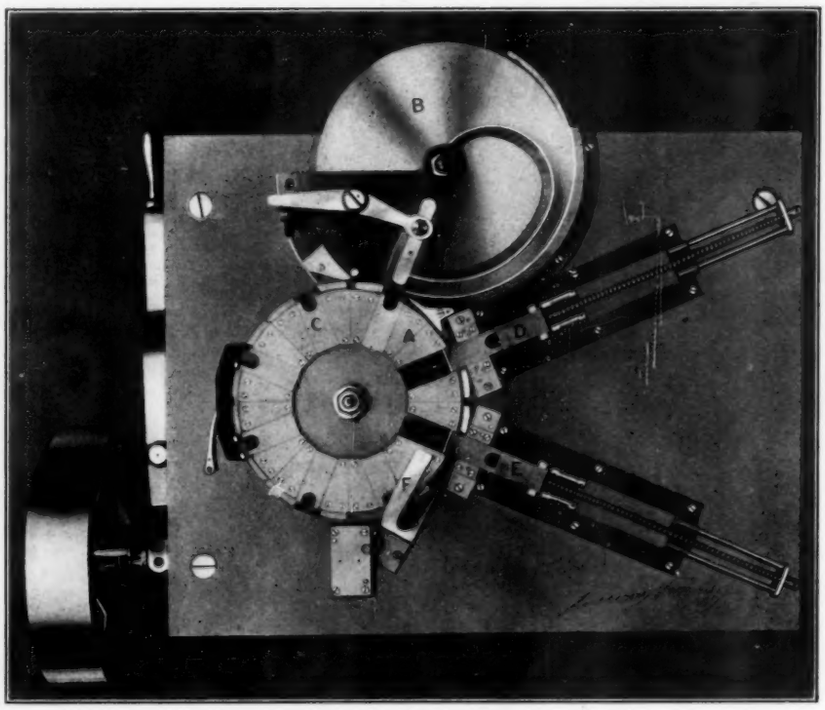

FIG. 43. CARTRIDGE-HEAD GAGING MACHINE.

five heads. The view to the left shows a clip just being drawn on, while in the other view the feeding device is returning for a second clip. Upon the clipped ammunition arriving opposite the chute at the rear it is lifted from the turret and dropped out of the machine by a vertically reciprocating arm carrying, as shown, a pair of spring fingers.

It has already been stated that the ball ammunition is 0.10 inch longer than the blank to prevent accidental assembling of a stray ball cartridge in a clip of blanks. Should such a cartridge get into one of these machines engaged on blank work, its head would project above the other cartridges and the clip guide far enough to prevent the clip being drawn forward, and the machine would then stop. There are quite a number of these assembling machines in use, and each handles about 100 cartridges per minute. They were invented by Major Lissak, of the Ordnance Department, who has also devised many other special machines used at the arsenal. One of these which should be of interest in connection with the gaging operations noted above, although designed for facilitating the inspection of empty cases rather than loaded cartridges, is illustrated by Figs. 42 and 43.

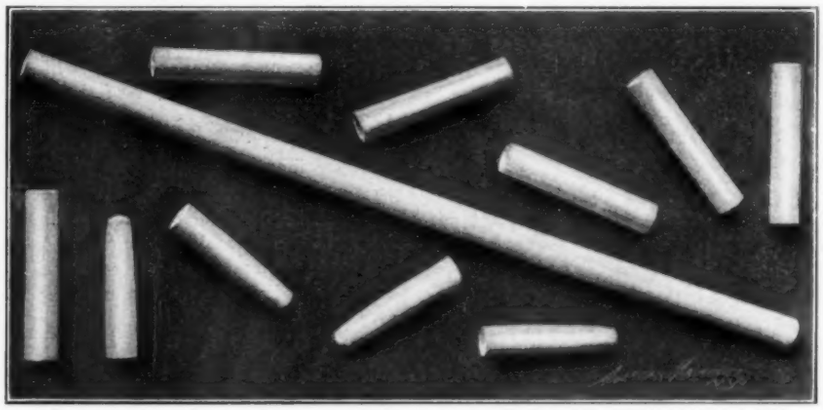

FIG. 45. PAPER TUBE AND BULLETS FOR BLANK CARTRIDGES.

A GAGING MACHINE.

This was primarily constructed for gaging the thickness of heads preliminary to the loading of the shells, and consists of a notched disk or dial *A*, indexed by suitable mechanism, and supplied with shells by a rotary plate *B* at the front. A series of inserted slides *C* in the disk receives the shells, and these receivers or holders are adapted to be engaged at the proper moment by a pair of radially arranged slides *D* and *E*, mounted on the table. Under these latter slides are located gage-plates, the first (under *D*) with a channel or opening too shallow for a head of standard thickness, and the second (under *E*) with a channel representing the maximum thickness permissible for the head.

The two slides *D* and *E* are given a radial movement at each dwell of the plate *A*, by cam-actuated rods which are provided with spring connections as shown. Now, as the first case, say, in the index plate, comes opposite the first gage (as in Fig. 42), its receiver engages the first radial slide *D*, and as the latter is acted upon, the shell, if its head is below the proper thickness, enters the minimum gage and is drawn back until it drops through an opening and out of the machine. If the head is too thick to enter the minimum gaging channel, it resists the action of the spring, and at the next step forward of the dial the shell-holder is grasped by the second radial slide *E*, which then moves to the rear with the shell—provided the latter's rim is not too thick to enter the maximum gage—and the case drops into the receptacle for perfect material.

In the event of the flange or head being so thick that it cannot slide into the maximum gage channel, it overcomes the effort of the spring to draw it out of the index dial, and at the next advance of the latter it is withdrawn by a slotted guide *F* and dropped into another receptacle. The work is thus automatically tested by limit gages, and, if not conforming to the established limits, is mechanically separated from the material which is perfect.

It is obvious that, where desired, the machine may be arranged to gage the diameter instead of the thickness of the head.

TUBE MACHINERY FOR PAPER BULLETS.

Another special machine devised by the same officer is shown in Fig. 44. This cuts up paper tubes into correct lengths for paper bullets for blank cartridges, and Fig. 45 shows a tube before and after cutting, also several paper bullets with the ends closed up to receive the bursting charge of powder. A view in the department where the tubes are rolled and cut is given in Fig. 46. The paper used is heavy linen note, cut to 8⅜x4 inches. In rolling, the long edge is slipped into a slit in a steel rod of the required diameter, and the end of the rod slid into a spindle shown at the end of the bench, the handle being held by the operator, and the work, while rolling, resting in a half-round

FIG. 46. ROLLING PAPER TUBES FOR BLANK CARTRIDGES.

FIG. 47. VIEW IN PAPER BOX SHOP.

groove, to insure the paper being drawn smooth and tight. The outer edge of the paper has already been coated with paste, and upon winding over the tube holds it in shape, so that the rod may be removed at once. The operators of these machines become very expert and require but a few seconds to roll the paper and remove the tube.

The tube-cutter, Fig. 44, has an arbor with five rotary knives, and at either side is a gear-driven cylinder with notched flanges for feeding the work past the cutters. A brass rod, scored at the proper intervals, is slipped into each tube before it is placed in the machine; and as these rods drop out again the work, now cut to length, is slipped off.

The cylinder for the blank bullet, before forming up, is about 1⅝ inches long. It passes through a simple form of power press fitted with the necessary punch and dies, and here one end is closed tight and the body given a conical form similar to the nickel-jacketed bullet. After the charge of powder is put in, a drop of shellac is brushed over it to keep it in place and exclude moisture. The paper case itself is protected from dampness by the coating of paraffin which it is given later on. Some of the operations just noted are shown in Fig. 36, which was referred to earlier in this article.

CARTRIDGE PACKING.

After the cartridges, whether ball or blank, have been assembled in their clips as already described, they are ready for packing, which is done in the boxing and packing shop at the end of the main factory. The ball ammunition is placed in bandoliers, which are made on the premises, sixty cartridges being placed in each bandolier. This affair has a shoulder-strap, and there are six pockets, so two clips are inserted in each pocket. A piece of tape is placed along the tops of the pockets, and the open ends are sewed up by machinery. The tape of course forms a means by which the pockets may be easily opened by the soldier. Twelve hundred cartridges (in twenty bandoliers) are packed in a hermetically sealed zinc-lined case having a tin cover soldered on, and in this cover there is a small handle by which the case may be torn open.

The blank cartridges (like the dummy gallery-practice and guard ammunition) are packed in pasteboard boxes instead of in bandoliers. These are made in a well-equipped box shop, Fig. 47, on the second floor of the packing section. Four clips containing twenty cartridges are packed in each pasteboard box, and the box, when closed, is stamped with the name of the packer.

To provide further against possibility of a ball cartridge getting into a box of blanks, each box, as packed, is placed on a pair of even balances and weighed against a standard box of blanks. An electric bell is located at the rear of the scales, and if by chance there should be a ball cartridge in the box being tested, the extra weight of the bullet would cause the opposite side of the scales to rise and ring the bell.

In the various departments of the cartridge factory, as described in this and the preceding article, there are employed at present about 650 people, most of whom work by the piece.

The Selection of Material for the Construction of Hydraulic Machinery.*

BY ARTHUR FALKENAU.

In the designing of hydraulic machinery, one of the most important considerations is the determination of the material to be used. The determining factors are: First, the function of the machine or appliance; second, the space available for placing the apparatus; third, the hydraulic pressure involved; fourth, the velocity of flow of the water or other liquid; fifth, in the case of pumping machinery, the kind of fluid to be pumped. Possibly I should have mentioned the last consideration first, but in speaking of hydraulic machinery I had in mind mainly hydraulic presses working under the higher pressures. As to the functions of hydraulic machines or appliances, they can be divided into four great classes: First, presses and intensifiers; second, pipes; third, valves; and fourth, pumps.

Of course, the first consideration in designing a press is the total pressure to be exerted, and the second is what hydraulic pressure is to be used or is available. This is at times governed by the space available for the machine, and I have known of instances where, in order not to have too cumbersome a machine, and the space being limited, it became necessary to use a factor of safety of three to four, referring to the ultimate strength of the materials of construction. Of course, in every construction the expense is to be considered, and this frequently determines the choice of gray-iron or steel castings for hydraulic cylinders. At times, extreme high pressures indicate the desirability of using steel forgings for cylinders. If the cylinder is to receive a plunger which can be packed externally, gray-iron or steel castings prove very satisfactory; but where a piston is to operate in the cylinder, on account of the wear of the leather packing, a forged cylinder, bored and ground, gives the best results. With castings, a copper lining is frequently resorted to in order to present a smooth surface to the leather.

A most important consideration is the density of the material, entirely aside from the tensile strength. Water under 3,000 or 4,000 pounds pressure will ooze through cylinder walls made of ordinary gray iron 3 or 4 inches thick; that is, if it is open-grained iron. For these high pressures, it is usual to use air-furnace iron, which, besides giving a tensile strength of 30,000 to 32,000 pounds, furnishes a very dense material, and now that steel castings are so much more reliable than formerly, steel castings are supplanting the air-furnace iron.

In this connection, I would say that in my experience, however, I have known air-furnace iron to fail where a good, ordinary casting was successful. This was largely due to the manner of the casting and local shrinkages from gates and risers. The failure of cylinders or valve-body castings to be thoroughly impervious to the water is frequently the cause of great annoyance and expense in the construction of hydraulic machinery. I have had cases where, on account of the anxiety of the customer to obtain the machine, we have had to pass cylinders or valve bodies which, when first tested, failed to hold the pressure, the water oozing through the walls quite rapidly. We remedied the defect by pumping starchy fluid, prepared from potatoes, into the cylinders, and after half an hour to an hour's work, the cylinders were bottle-tight. These cylinders were put to work under water pressure of 1,500 pounds, and they have remained permanently water-tight. I designedly use the word "water-tight," as a later experience proved to me that the starch-calking method is not oil-tight. In building some 200-ton presses with 10-inch cylinders we used cupola-iron castings. As they proved defective, we next ordered some of air-furnace iron. After trying three of these, all of which proved defective, in order to meet the importunities of our customer, we concluded to try the starch-calking method. Within a half hour the cylinders were perfectly tight, and after having a hydraulic pressure of 400 pounds per square inch applied to them, and locking this pressure in the cylinder, a drop of only 10 pounds was recorded after 12 hours. We thought that our annoying problem was solved, and expedited the machine to the customer's works. The next morning we were informed that the cylinder was leaking badly, and on inspection found that our customer was using oil, and that the oil oozed through the cylinder at an apparently greater rate than the water had done originally. I suppose that the oil must have had some dissolving effect upon the starch. As we had had such unsatisfactory results with the air-furnace iron, I concluded that the only rapid solution of our trouble would be some other way of sealing up the pores of the cylinder. As the leak indicated, the porosity was mostly at the bottom of the cylinder. We therefore had the inside of the cylinder toward the bottom brazed by the ferrofix process. This proved entirely successful, and the cylin-

*A Paper read before the Mechanical Engineering Section of the Franklin Institute.

der has remained sound ever since. I understand that in the case of steel cylinders the sealing by means of the thermit process has been successfully used.

It may be interesting to note here that in the year 1849 the first cylinders used in the hydraulic presses constructed for raising the tubes of the Britannia bridge into position proved porous and leaky, and were made tight by pumping oatmeal gruel and sal-ammoniac into them. These gray-iron cylinders were 20 inches in diameter and had walls 8¾ inches thick. When they failed, they were replaced by cylinders made of wrought iron with 8-inch walls. When the wrought-iron cylinders were first put to work, the engineers were discouraged, due to the fact that the cylinders expanded under the great pressure, causing the pistons to leak. New pistons were made, but the expansion continued. The outer diameter, however, remained constant, and this encouraged the engineers to persist in making new pistons until the inner portions of the cylinders had taken a permanent set.

In valves and pumps, where water under high pressure attains a high velocity, it has been a general experience that gray iron and steel are frequently subjected to peculiar cutting action. According to my own observation, this cutting action has been decidedly more rapid and marked when two dissimilar metals were in contact; thus in the Loss valves which we built we originally used steel valves and bronze bodies. In several instances, after a year or two, we found the steel valve apparently eaten out as if by an acid. In one particular instance, believing that acid or grit in the water was the cause of the trouble, a water filter was put in place and only pure filtered was used throughout the system. The new steel valves were soon eaten as badly as the former ones. It may be that some tannic acid washing out of the leather packings had something to do with this action, or the action may be of an electric nature. We replaced the steel valves by bronze ones, so that two like metals were in contact and no further trouble was experienced. I have examined samples showing this peculiar pitting action which, as the location showed, could not have been caused by the impact of the water, due to high velocity in passing out of the valve. Still, the fact that this action occurs near the point of efflux, and not so much elsewhere, might lead one to discountenance the electric couple theory. This peculiar action, I believe, has been observed by a great many engineers, but does not seem to have been satisfactorily explained. For small structures under high hydraulic pressures, say from 3,000 to 8,000 pounds, forgings are far more satisfactory than any casting, and I have found bronze under these high pressures unsatisfactory solely to the low or uncertain elastic limit of the same. The castings seem to gradually expand and get leaky, although figured with the factor of safety of 6 to 10 based on the ultimate strength.

The material to be used for packing is also an important consideration. Where "U" or cup leathers are used a close-grained flexible leather is desirable; of course, such leathers should not be taken except from the middle of the back of the animal. Leather treated with paraffin has given good results. There is no doubt that the method of preparation of the leather is an important factor in its imperviousness to water, and I have within recent years tried the Vim leather, which has given better results than any I had heretofore used. The manufacturers of the Vim leather claim that their peculiar process of tanning preserves the fiber and brings the fibers into closer contact. The process of tannage is one of oxidation by the use of a mineral, and for this reason the leather is not affected by oxid of iron, as are oak- and hemlock-tanned leathers. For light pressures the leather is furnished without any filter, but for high pressure the leather is filled with a lubricant which primarily hardens the leather and renders it more impervious. It is claimed that owing to the process of tanning the Vim leather will absorb 45 per cent. of lubricant, as compared to 15 per cent. absorbed by oak-tanned leather. Furthermore, in molding the leather no water is used, the leather being heated and thus sufficiently softened. The leather is not affected by hot water.

The blame for the failure of leathers, however, is frequently not chargeable to the material, but to the construction of the metal against which the leather rests. The "U" leather should, as far as possible, be backed by the metal over its curved portion, and should have either a metallic ring or hemp or other material inserted between the flaps. Furthermore, the surface over which the leather runs should be as smooth as possible. Some constructors, in building cylinders in which pistons travel, line them with brass, aiming at the double purpose of furnishing a smooth surface and covering any porous structure which may appear in the gray-iron or cast-steel cylinders.

Where leathers are used in valves in such a way that they cross ports the construction should be such as to avoid blowing the leather out into the ports. I desire, however, to confine myself to the question of the kind and quality of the material to be used, and only call attention to these points of construction which, if neglected, may cause damage which should not be charged to the material.

In choosing the material for pumps used in removing fluids, such as mine pumps, ammonia pumps, etc., the question of chemical action on material is of great importance. In many of the mines in the anthracite coal regions the water is so permeated by sulphuric acid that gray iron cannot be used with any satisfaction. For several years I had preserved a specimen, which I had broken from a pump that had been in use some four years. The metal had been ¾ inch thick. This was no longer gray iron, as the iron had been removed and only the graphite left, and I could write with it as with a pencil.

Worthless Patents.

The journal mentioned below endorses our views (and adopts our language) as follows:

The *Operative Miller* has frequently called attention to the many patents being granted which are absolutely worthless. The claims made are apt to be so very ridiculous that one stops to wonder why it is so stupid an inventor should happen to appeal to a patent attorney who is either gloriously incompetent or criminally reckless. It was only a few months ago when a foreigner had a few dollars to throw away for a United States patent on a system of grinding and bolting which would have disgraced the science of milling fifty years ago. This issue contains the report of a patent on preventing the feed to a millstone from choking. Every miller who had any experience with millstones twenty-five years ago knows that this sort of device was common long before that time.

The patent papers are usually well gotten up, with respectable drawings, ample and clear description, and "claims" which seem to claim everything in sight. Thinking millers and machinery experts are apt to ask the question: "How about the morality of Uncle Sam accepting jobs that can only result in loss and disappointment to the author?" No sensible person likes the spectacle of the United States government taking the money of an inventor for the protection of a thing morally certain to be worthless. We will not assume to sit in judgment on the action of a prominent firm of patent solicitors in preparing an application for such a patent. The argument justifying themselves for doing so may be the same as that of the mill builder who does experimental work on certain special machines simply to satisfy the curiosity of some miller customer and knowing it to be useless. Most people prefer to do work in the doing of which there is at least some small hope that the one who pays for it can get his money back without cheating anyone else. Besides, where the proprietor of a shop is simply paid for doing work in a certain specified way, and his advice and opinion are not asked, the case is entirely different from that of a patent attorney, who in taking a case makes himself the adviser of the inventor and must be placed in more or less confidential relations with him. We will all admit that a man who poses as a patent attorney cannot be posted in all lines of manufacture. Still when he himself is unable to decide in behalf of his client, he is morally bound to call someone else into the deal who really does know.

Automobile Construction—III.

BY F. C. MASON.

This article will deal with the transmission, fly-wheel and clutch. With the transmission proper you get two changes of speed ahead, and the reverse. In automobile parlance, with this transmission it would be three speeds and reverse, as they count the engine on the high speed as one.

Fig. 9 represents a plan and an end view, showing the shape of the case, and hangers and gears in mesh for reversing; parts are also shown in detail. The construction of this transmission is such that when on the high speed ahead the drive is direct from the engine to the rear axle, and not through any gears.

The driving shaft *A* has three gears, Nos. 1, 2 and 3. Gear 1 is to operate the back-gear shaft *B*, which has gears Nos. 4, 5, 6 and 7 attached. Shaft *A* rotates in the clutch-quill *C* until the latter is engaged by the sliding gear, which, when slid clear ahead, is locked to *C* by the three pins in the clutch, which engage corresponding holes in the gear itself. This gear is worked by a shifter rod connected to a hand lever, which is attached to the outside of the frame and comes up to a convenient place near the driver's seat. The lever must be provided with a quadrant and lever lock, and the quadrant notched to correspond with the different speeds and have one notch for a neutral, between slow speed and reverse.

When gears 2 and 5 engage, the drive is from gear 1 to 4 (back gear) and from gear 5 (back gear) to gear 2, giving the high speed ahead on the change gear. When gears 3 and 6 engage, the drive will still be through the back gear, giving the slow speed ahead. When gear 3 and intermediate gear 8 engage, as the intermediate meshes with gear 7 on the back-gear shaft the reverse, or back up, is obtained.

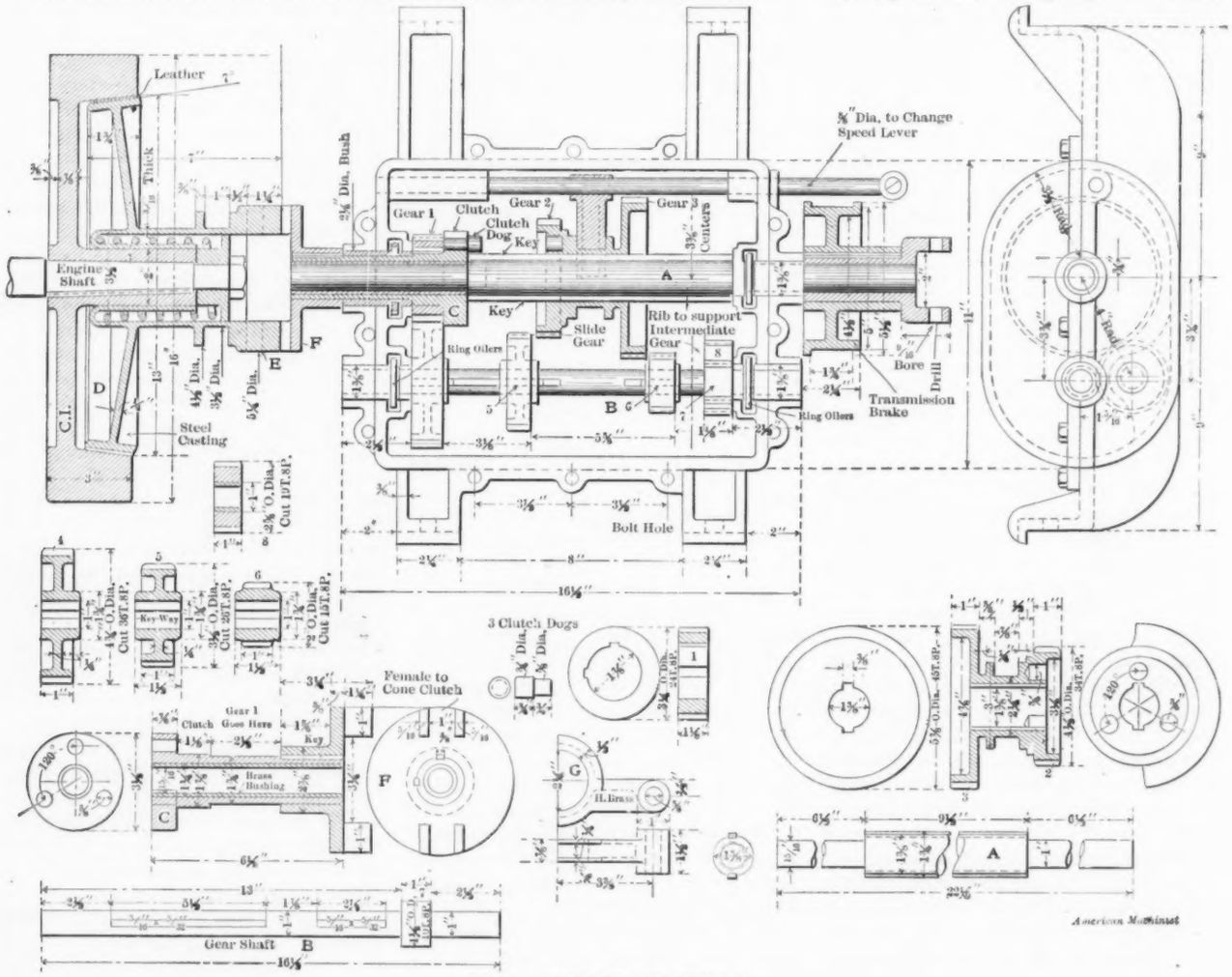

FIG. 9. GEAR BOX AND DETAILS.

Assuming that the engine is running 1,000 revolutions per minute, the speed for the various changes would be approximately as follows in miles per hour, with wheels 32 inches diameter and an axle reduction of 4 to 1: High speed, engine direct, 23½ miles; first speed on change, 12 miles; second speed or slow speed ahead, 5½ miles; back-up speed, 3½ miles. With the regulation of the engine you can run faster or slower, as you may desire.

The gears for this change box are all made of machinery steel and case-hardened. The slide gears (2 and 3) are made integral and the shifter fork works between. It has two keyseats diametrically opposite, ⅜ inch wide by 3-16 inch deep, to correspond with the feathers in shaft A.

Another way to produce this job would be to make the shaft square and machine the gears to fit. Most manufacturers do this to do away with the keys and the bother attached to them when in use; but the key method is much easier, and if the work is properly done will answer as well.

The shafts *A* and *B* should be case-hardened and ground to size, if facilities are at hand for doing this. The fly-wheel is held on the engine shaft by a key, washer and nut. The washer also acts as a backing for the coil spring. The clutch *D* is held locked to the fly-wheel by the coil compression spring unless released by a foot lever. The clutch is connected to the transmission by a two-jawed male and female clutch, *E* and *F*, which allows a movement endwise of ½ inch. This clutch also acts as a semi-universal joint between engine and transmission.

The gear box should have at the top an oil hole for filling the case, tapped, say ½ pipe tap, and fitted with a plug; and at the bottom there should be a pet cock to draw off the oil if necessary.

The gears 2, 3, 5, 6, 7 and 8 should all have the teeth ends rounded off, to make

them mesh easily when making the sliding change. The transmission brake and universal joints, of which part are shown, will be given in detail later.

The gear box may be made of either gray iron or aluminum.

Echoes From the Oil Country—Early Engine Design—Bouquets or Bricks.

A gentleman, whom I had first met at one of the meetings in New York of the American Society of Mechanical Engineers, had been in town for several days on professional business, and had been very hard at work. He had, in the course of his labors, been trying to extract information of various kinds from me, so that I was not surprised when he opened up a map and began to ask me about the country.

"There is no use of your looking for any towns over through there," I told him. "You can find them on the map, but that is the only place you will find them."

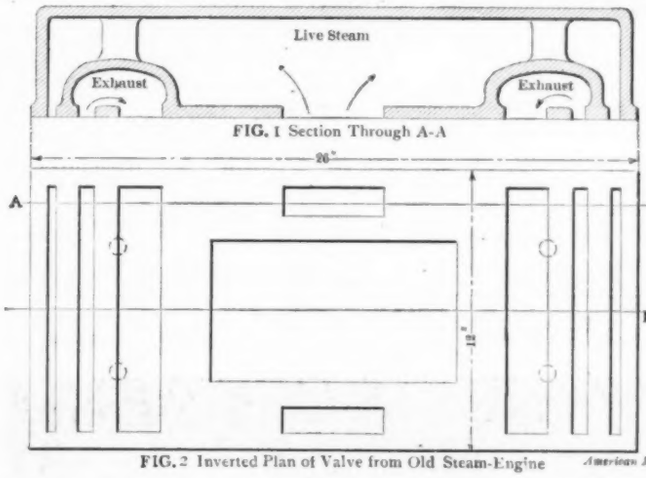

FIG. 2 Inverted Plan of Valve from Old Steam-Engine

FIG. 3 Section Through Guides

"That will just suit me then," said he, "for it is wild country that I am looking for. I thought you could tell me where to find it." Seeing my inquisitive look (I do not think it is improper to be inquisitive with a man who is busy pumping me for information), he explained: "I have been working early and late, holidays and all, and coming down here has given me a little chance to take a breath. I have brought my one-man camping outfit along, and by working hard I hope to get through early enough on Saturday to get out of town into the wilderness somewhere. As Tuesday is the ever glorious Fourth of July, I will only need to miss one day to get a nice little outing."

"I can very readily tell you where to find the wild country, but it may bother you somewhat to get your outfit out and back."

"I can carry it all with food enough to last me the few days I will be out, so I can get anywhere that a man can walk."

Here was a matter of transportation. I had "backed" many a load of tools and parts of machinery, but I had never carried a house, with all the necessary furniture and a stock of provisions, for one load.

"I am a tenderfoot of the worst kind, but if it wasn't for spoiling your outing I would be tempted to try and induce you to let me go along," said I. "I would be delighted to have you go," said he. I think he did not know how really green I am in such things. "You will not need much. A piece of canvas, a blanket, and a little more food. Of course a little tin pail and a knife, fork and spoon, etc., will be handy, and you will want your fishing outfit." I got the things necessary for my lesson and we went.

Did you ever study your ordinary relations to your fellow-man from the standpoint of doing most of these things for yourself? Six cents per ton mile for railroad freight transportation may or may not be fair, but it has a new meaning when one is transporting thirty pounds three miles an hour on his back. Nature joined in to help me get all the information possible out of that trip, for it began to rain before we had selected a site for camping. This gave an opportunity to find out the heat developed by a match, and its efficiency as applied to the driest wood that can be obtained in a hard rain and reduced to shavings with a wet knife, even if the operator was trying to keep away from the wet under a piece of canvas that had ways of its own in letting in the water. The angle which a piece of canvas must be made to assume, so that a drop of rain will run over it with sufficient velocity to not go through was very nicely and practically illustrated. As I do not know how to cook even in civilization, I had an excellent chance to observe the affectionate action of the smoke as it lovingly followed my friend around the fire, while he got dinner. I had supposed that the saying that the smoke would follow a man around was a joke, but after thinking it over I have concluded that a man makes a sort of one-sided chimney that reflects some of the heat, and so helps to create a draft up along his body, and so does attract the smoke enough to decide its direction in a calm. The old Indian expression, "White man build such big fire he can't get near enough to it to get warm," turns out to be true also, as the draft caused by a big fire will chill the side that is farthest from the fire, especially if the clothing is damp, so that it takes constant turning to get even moderately warm.

While the rain gave a considerable experience in some lines, it spoiled the fishing, and to fill in the time that was not taken up with cooking and dish washing we set out to explore the surrounding country. In a clearing we found what had at one time been a sawmill. Judging by the ruins it had been a large one for this part of the country, and judging by the condition of the surrounding country a lot of lumber had been made in it. Most of the engine remained, and we found it most interesting to read the records of the past as they had been left on it.

I have been used to seeing old engines ever since I have been in the business, but this one was a stranger to me. The nameplate said Sharps, Davis & Bonsall, Buckeye Works, Salem, O. The general design said it was one of the pioneers. I was without any means of accurate measuring, so the sizes I give may not be very accurate, as I generated a standard foot on a twig by using my hands as a reference gage to check what my eye thought was right, and subdivided that into inches. From this I judged the engine to be a 10x18 inches. The valve was 12x26 inches and the steam chest was longer than the cylinder. It had been made that way to allow of the steam ports being made short and straight. The matter of steam distribution had received very careful consideration, as the free-hand sketch (Figs. 1 and 2) of the valve will show.

Whatever the engine may have been in service in a general way, there were some things that seemed to speak for themselves in the remains. The valve and seat were smooth and true, and without a scratch in them. This is something very rarely found even with engines which receive the best of attention, and they did not show any evidence of ever having been replaned. The bearings on the crankshaft were also in first-class condition. The weak points seemed to be in the parts which were keyed together. The engine was a side-draft, and the valve motion was given by an arm keyed to the end of the crank-pin. This arm evidently had a habit of working loose, as the key was shimmed up with an assortment of tin, and the arm was badly out of true. The crank-disk was cracked and had a band shrunk on. The key in it had also been giving trouble, and had shims on three sides. The flywheel hub was cracked and banded, and its key was liberally supplied with shims. This flywheel was also a belt wheel, but

there was also a light pulley about 3½ feet in diameter on the shaft, and it had been necessary to put shims under the key of it. The bed of the engine was made so that it could be used as a heater if necessary, and a water pump set on columns which were just forward of the guides. These guides were made to be thoroughly adjustable in every direction

The valve chest was on top of the cylinder, and the round spots on the valve show where relief valves had been. Three of the holes were filled with pipe plugs, and there was a relief valve in the other one, or at least I took it for a relief valve, as it was a valve that opened outward and was held to its seat with a spring. Perhaps it was intended to leak enough

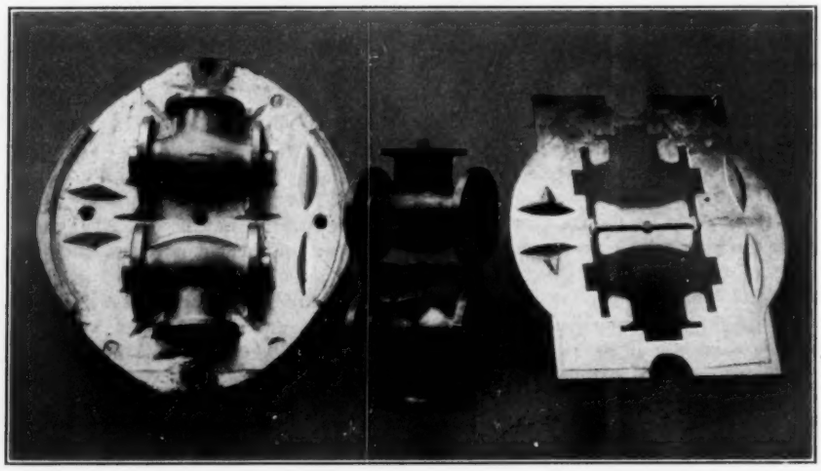

FIG. 14. PATTERN PLATE, CASTING AND STRIPPING PLATE FOR VALVE BODY.

by means of slotted holes where they were held together and to the bed, and after the adjustment was properly made it depended on the friction grip caused by the bolts (Fig. 3). The steam-chest cover was off, and the valve was out, so we had a good chance to see the valve details; the crank bearings had been taken away, but the cylinder heads were bolted fast, so that we could not see inside of the cylinder. The steam-chest cover was about 16x34 inches, and was only ⅞ inch thick, but from the looks of the packing which was sticking on the joint, it did not seem to have been giving trouble. The rear cylinder-head bolts showed signs of having been much used, and some extra holes had been drilled to help the original ones out.

As this engine sat in a solitude, the only information at hand was such as it gave, but after my return to civilization I wrote to a friend who is now in Salem, O., to see if I could get any additional information. From him I learn that it was built by what has since developed into the Buckeye Engine Works, and that a designer, who is still living and who went to work for them in 1853, says it was before his time, and that there are now no drawings of it. This would seem to put it back over fifty years, and its latter use was probably entirely unlike anything the designer ever thought of in the way of steam pressure and speed, while the fact that it was used until the business in which it took part was no more would indicate that it gave satisfaction to its owner. He may even think it has yet some value as an engine, or he would haul it away and sell it for junk.

to allow some pressure on the outside of the valve, for without any pressure there it would seem as though the valve would be raised from its seat. It did not have any bearing on the steam-chest cover, and its weight would not be enough to balance the area of the ports.

It certainly was a fine flower that C. A. Seeger sent my way, and which you displayed at page 607. I am glad that he saw fit to send it while I am still in the land of the living. It might not have reached me had he waited until the usual time for flowers. I prefer flowers to bricks, but if he, or anyone else, feels disposed to heave a "brick," as he intimates that he might at some future time, I hope he will let it come.

While a brick might not indicate that the thrower was in entire harmony with me in some things, it certainly would indicate that he had been aroused to action, and that there might be more to follow unless I could justify my actions. It would show that my efforts had landed. Even if one sends what he thinks is a flower, and it is taken to be a brick, he still likes to know that it has been received.

I know that the readers of the AMERICAN MACHINIST would never have received so much essence of machine shop from me had it not been for the flowers and bricks, for from the first I have realized that the flowers did not come as an appreciation of literary work, but as a tribute to the real life of the shop, which will ever be of more interest than the machinery or the output, *to the men in the shops*. Even a poor picture of a home scene is of interest if seen by one who is part of that life, but I have realized that many of my pictures are worse than the one Dixie tells of making of the cow, and I believe that one was taken for a dog for want of a proper label.

I have had my hand on the shipper, and have been ready to take off my overalls more than once. It may be a poor return to my friends to intimate that the flowers and bricks and other marks of appreciation have been the deciding factors that have kept me on the job, but so it is.

May they all work for appreciative bosses. W. OSBORNE.

We are in receipt of the "Bulletin" of the United States Trade-Mark Association, which is issued by the association from its office, 32 Nassau street, New York. It contains the record of a number of interesting decisions of the courts pertaining to matters of copyright, and a glance through its pages gives one a new idea regarding the meaning of many of the familiar trade-marks and names of widely advertised goods.

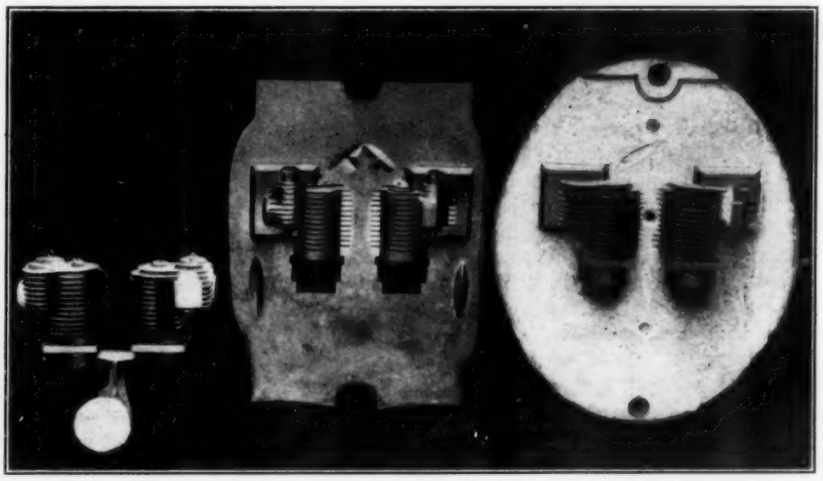

FIG. 15. CASTING, STRIPPING PLATE AND PATTERN PLATE FOR AIR-COOLED CYLINDER FOR MOTORCYCLE.

The "Universal" System of Machine Molding—II.*

PATTERN PLATES AND THEIR FABRICATION.

It is well known among founders that the greatest obstacle to the general employment of mechanical molding proceeds from the high cost of the necessary pattern plates and the long time usually required for their preparation. We will forthwith review, with the object of showing their lack of complete satisfaction, some of the methods which have been tried.

One of these methods consists of making with a two-part flask a mold of the pattern to be reproduced; then, after drawing the pattern, to place between the cope and nowel a frame of a certain thickness of metal or dry sand. When the mold is poured we obtain, in gray iron or bronze, as desired, a plate bearing in relief on each face a half pattern. This method presents many inconveniences. In the first place, such a pattern plate can only be used in machines of the roll-over type, which, because of the necessity for locking the flask in place, and the rotation for each half mold, does not permit of much rapidity. Then, as the pattern plate is usually poured in iron or bronze, it is necessary to make the first pattern with double shrinkage. Now, it is sometimes necessary, especially in the case of jobbing foundries, for them to use a pattern which is going to be delivered to the customer under penalty of being obliged to make another one at their own expense; in which case, of course, the method described would not serve. Moreover, the pattern plate must be filed and polished before it is used; and this method is not serviceable, except for simple pieces, easy to draw.

Another method consists of preparing metallic half patterns and fixing them by means of screws to a plate which has previously been planed smooth. This method is the longest and the most expensive. The first and not the least inconvenience is the necessity of construction in a shop other than the foundry. There is great difficulty in fixing the half patterns well in their places, so as to avoid fins on the castings, especially when it is a question of a great number of very small pieces. This difficulty is augmented when the parting surface is not flat, which case is frequently met with in the foundry. Furthermore, it is necessary to have two molding machines for each job, as the pattern plates can carry the patterns on only one side. They have recently tried the use of pattern plates and stripping plates of wood, made in the pattern shop. For simple work this method has given some results; but it does not apply except for simple jobs which do not take long to execute, as the plates do not last long, both because of their lack of strength and the action of the wet sand on the thin wood.

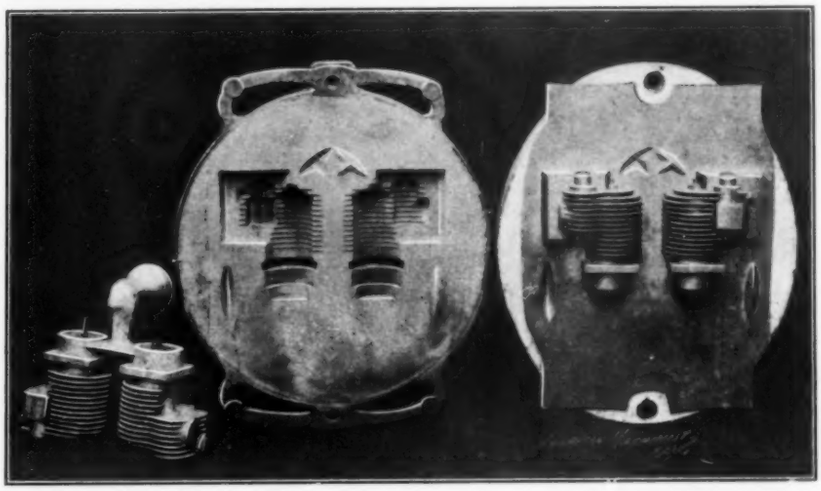

FIG. 16. MOLD AND PATTERN PLATE WITH STRIPPING PLATE SUPERIMPOSED FOR MOTORCYCLE ENGINE CYLINDER.

In another method they make a mold of the pattern to be reproduced and cover each of the parts with a plaster frame, thus producing two pattern plates. This method is very good when it can be applied, but this is only in the case of simple pieces without fragile parts and which can be easily drawn.

The method most frequently followed is to make the pattern plates and the stripping plates of metal, adjust them and polish them with care. It costs very much, takes long to prepare, and is therefore said to be out of the question when the job presents the least difficulty, so that the field of the molding machine is

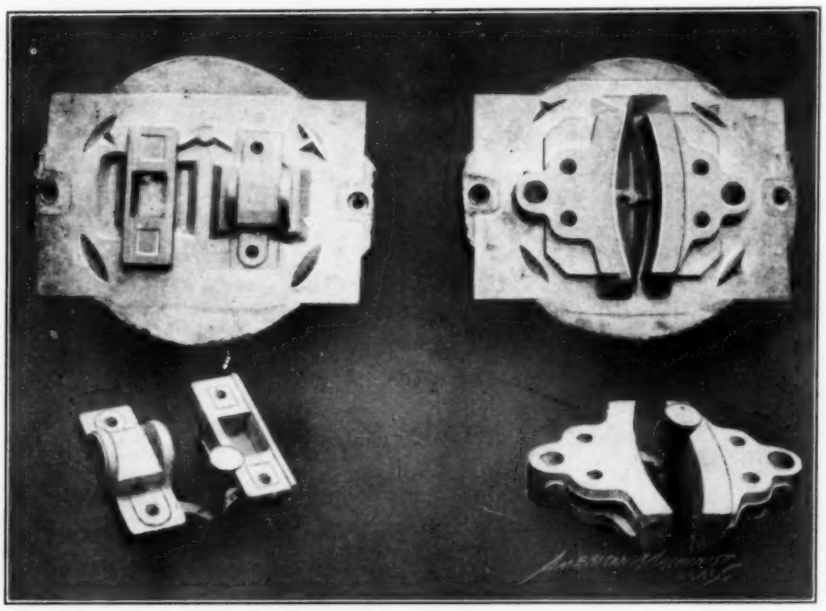

FIG. 18. SPRING BRACKETS AND BRAKE SHOES WITH THEIR PATTERN PLATES AND STRIPPING PLATES.

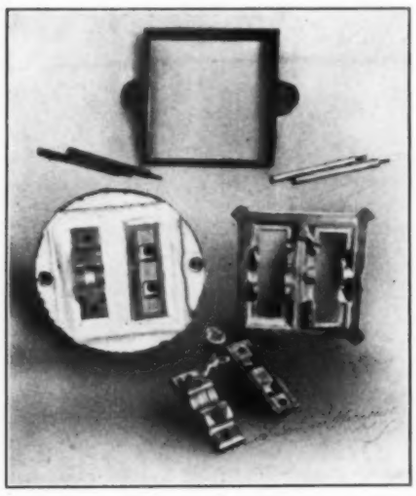

FIG. 17. THE REVERSIBLE PATTERN PROCESS WITH STOOLS.

*For preceding article see page 718.

limited to pieces which are relatively easy to make and of which the quantity to be produced is so large that a considerable preliminary expense may be justified.

From the foregoing it is evident that the molding machine by itself is an incomplete thing, requiring to be supplemented by a practical, rapid and economical system of preparing the pattern plates, which should be done as much as possible in the foundry to avoid delays and misunderstandings which may result from doing the work elsewhere.

THE "UNIVERSAL" METHODS.

The Bonvillain system has been the outcome of several years of experiment and experience, a few of the results of which are shown in the illustrations accompanying this article. As the different kinds of jobs encountered are so numerous, and it usually takes a good deal of description to make a molding operation clear, it will not be attempted to give a full description of all the examples shown.

The subject of pattern plates for molding machines may be considered under four different heads:

1. The reversible pattern-plate process, single or multiple, which uses but one pattern plate and molding machine.
2. The double pattern-plate process, requiring separate molding machines for cope and nowel.
3. Stripping plates.
4. What they call the reversible "cliché" process, employing a babbitt pattern plate,

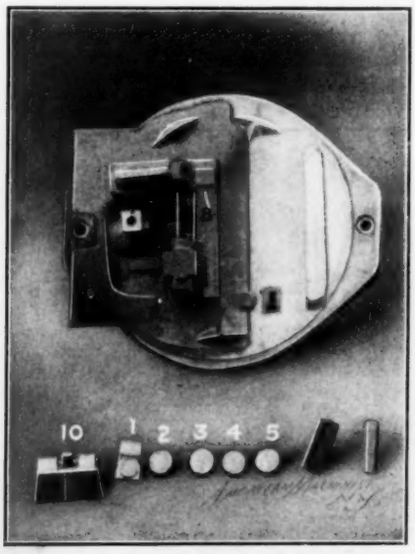

FIG. 20. OTHER PATTERN PLATE WITH ITS STRIPPING PLATE SUPERIMPOSED AND SOME MOVABLE PARTS FOR LATHE SADDLE.

embodying a number of the small patterns grouped upon its surface.

THE REVERSIBLE PATTERN-PLATE PROCESS.

The first system enumerated is the reversible pattern-plate process. In this the top and bottom of the same pattern are placed side by side on the same level on the face of the pattern plate, the arrangement being repeated if desirable and practicable, in order to produce a multiple pattern plate. Whenever the size of the pattern permits it, reversible pattern plates are employed, as then but one molding machine is required, the complete mold being made by closing together two half-molds made successively on the same machine. The pattern plates are generally made in plaster or cement, if only a few hundred castings are needed; if for a larger number, as for instance several thousands, all the external surface of the pattern, and especially the exposed edges, are made of a shell of white metal, having practically no contraction; the base of the pattern plate remaining plaster or cement. In making the pattern plates, ordinary wooden patterns and core-boxes only are used, as in common hand molding; but to obtain the necessary accuracy in the disposition of the top and bottom parts of the same pattern or patterns on one another, they use an equipment of special frames and appliances, which allow of great accuracy being obtained by an ordinary molder. Of course, great care and a certain amount of thought are required in handling the plant, but a man of average skill and intelligence can soon understand the best way to handle it so as to get the best results.

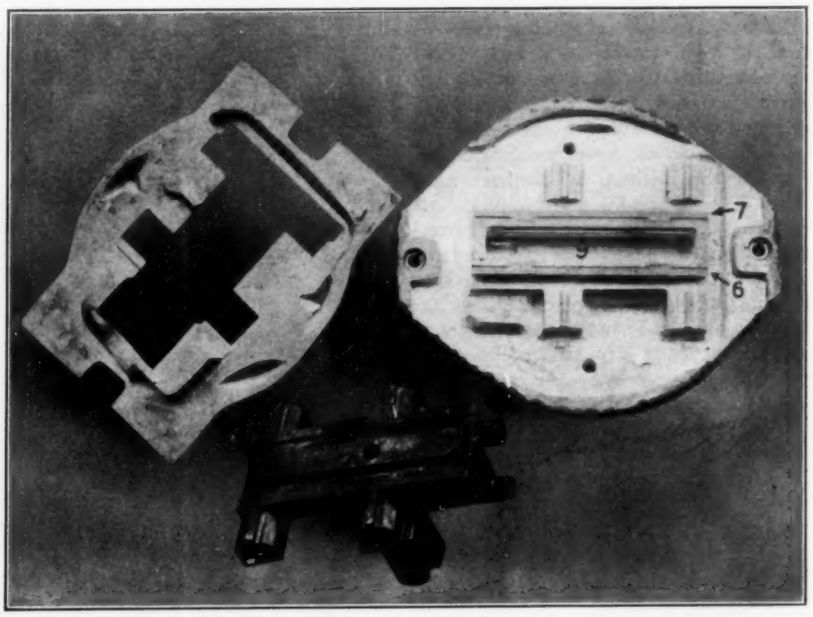

FIG. 19. STRIPPING PLATE, ONE PATTERN PLATE, AND IN FOREGROUND WOODEN PATTERN, FOR LATHE SADDLE.

Such pieces as brake shoes, flanged valves, etc., of such a size that at least two pieces will fit in the flask, are suited to this process. In Figs. 14 and 15 are shown examples of jobs of this kind; the pattern plate of the latter is shown in Fig. 16, with the stripping plate in place, enabling the mold to be obtained, as shown on the left of the picture. In Fig. 15 the stripping plate is removed from the pattern plate and stands alongside of it. Fig. 17 shows another job of this species, having the cores made in green sand on the machine with the mold and pushed out by stools. Fig. 18 shows a job of railroad work; on the left are two spring brackets and on the right two brake shoes; in the

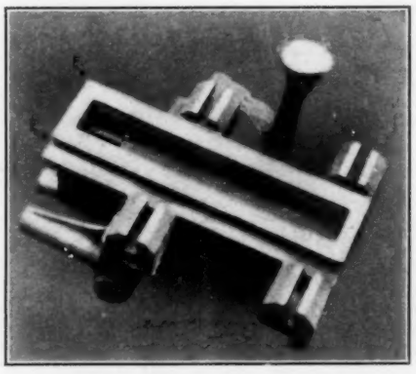

FIG. 21. LATHE SADDLE CASTING.

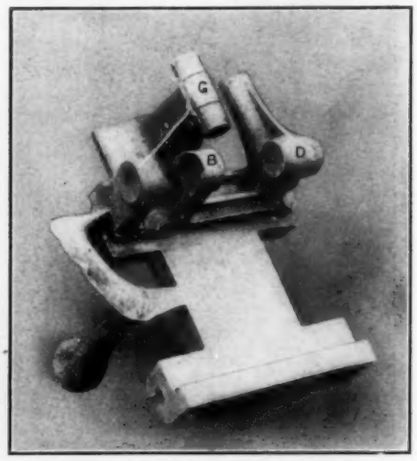

FIG. 22. LATHE SADDLE CASTING.

background are the pattern plates and stripping plates used for producing them. The brake-shoe job is a fine example of curved stripping plates.

THE DOUBLE PATTERN-PLATE PROCESS.

When the pieces are too big for the process just described, or when for any particular reason the pouring makes necessary some special position in the mold, two separate pattern plates are made, and two molding machines are used, one making the cope and the other the nowel. An equipment of special flasks and appliances is furnished for this method also, enabling the two parts of the mold to be joined together with perfect accuracy.

As in the case of large pieces in the preceding process, plaster is replaced in the thin parts subject to wear, by white metal, either solid or hollow, according to the case, being as economical as possible in its use. The patterns may be made in pieces, some fixed and others movable, which, after the drawing, remain buried in the sand and are drawn out separately. It is interesting to note that also with a pattern which cannot be separated into parts, it is possible to make a pattern plate which can be separated, without having to adjust the pieces to one another. Thus they are able to avoid molding in three-part flasks, as long as they are able to employ what they call "bouchons" or plugs.

Figs. 19, 20, 21, 22 and 23 show patterns and stripping plates and castings of a lathe saddle made in this way. The bosses *A* are shown at 8, Fig. 20, and 9, Fig. 19. 10, Fig. 20, is a "bouchon" or plug, which acts as a core-print for the part *G*, Fig. 22, in order to avoid the necessity for a third part to the flask.

Similar work is shown in Fig. 24. This gear, though simpler than the previous

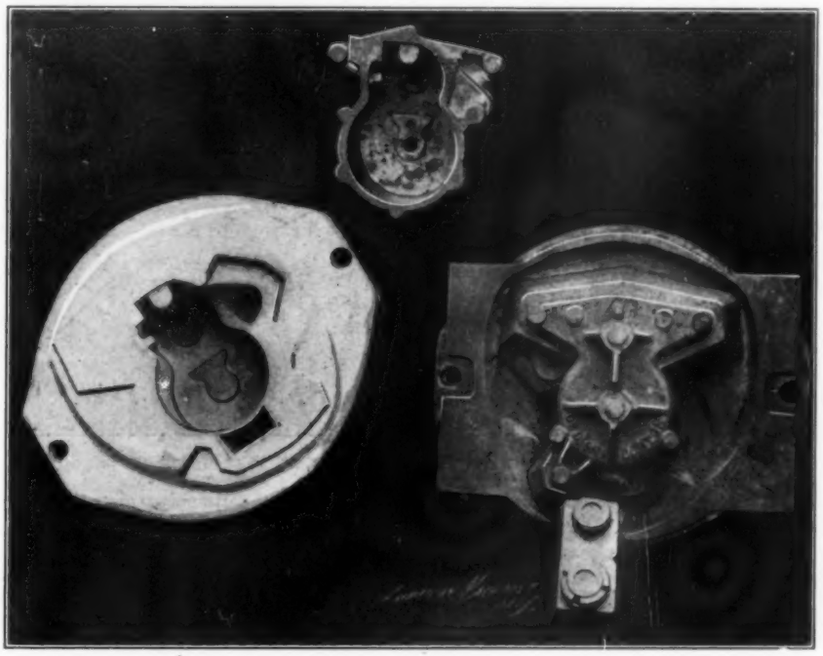

FIG. 25. EXAMPLE OF THE DOUBLE PATTERN PLATE PROCESS.

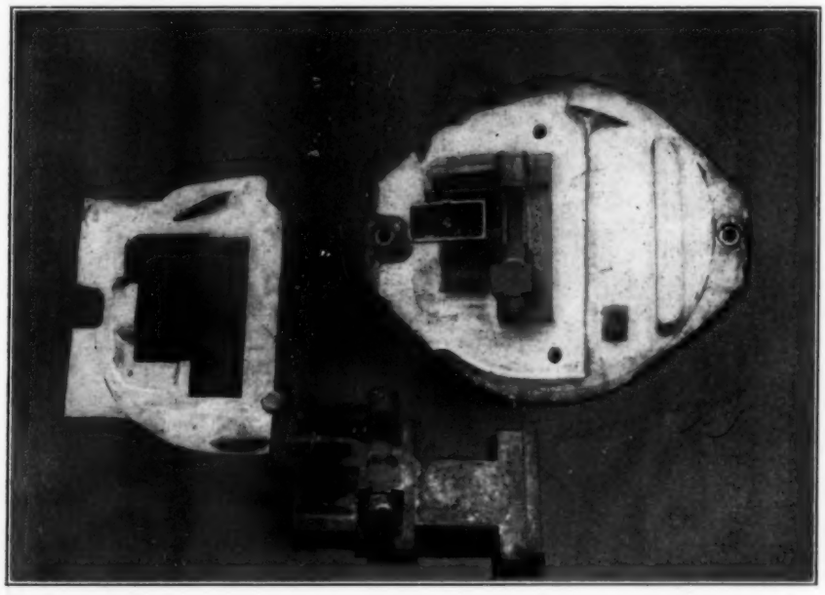

FIG. 23. STRIPPING PLATE AND PATTERN PLATE FOR LATHE SADDLE, LOOSE PIECES IN PLACE.

B C D, Fig. 22, are obtained through the use of five detachable pieces 1, 2, 3, 4, 5, shown in Fig. 20. The dovetails *E F* Fig. 21, are produced by the detachable pieces 6 and 7, Fig. 19. Stripping plates are used on both the pattern plates shown in Figs. 19 and 20. Inside stripping plates

example, still presents some difficulty in its molding.

In Fig. 25 is shown an aluminum casting for a De Dion-Bouton automobile engine.

Fig. 26 shows a dynamo spider; five stripping plates and four "plugs" are used in one of the pattern plates; four stripping plates in the other. Two of the plugs are shown in place, while two more lie loose at the left.

Figs. 27 and 28 show a variety of pieces made by this process.

STRIPPING PLATES.

It seems hardly necessary to say very much about the employment of stripping plates. As is well known, a stripping plate consists in principle of a plate sometimes of wood, but more often of metal, which is cut out to fit the exterior form of the pattern. Sometimes the stripping plate and flask are raised together, the pattern remaining fixed; or else the pattern is made to go down through the stripping

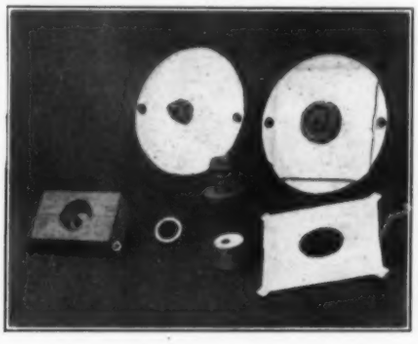

FIG. 24. A GEAR CASTING, AND THE PATTERN AND STRIPPING PLATES FOR MAKING IT.

plate, the latter and the flask remaining fixed. The result is the same and is excellent, as the stripping plate in either case supports the fragile parts of the sand during the operation of drawing the pattern and thus avoids subsequent patching of the mold.

Wooden stripping plates have been men-

tioned, but their use is not considered very practicable. Metallic stripping plates are made in two ways—either cut out in a planed metal plate, or else a hole a little larger than the pattern being made in a planed plate, babbitt metal is poured around the pattern, which must in this case be itself of metal. The babbitt metal unites to the planed plate quite well without any trouble and fits the pattern very closely.

In these two cases the process is costly because it necessitates the use of a planed plate. Moreover, the parting surface cannot be much different from a plane, which is not always the case in the foundry. Besides, it is necessary to put in the gates, which is slow, difficult and expensive. In order that the stripping plate may be used on a large scale, as well as for small jobs and for parting surfaces that are twisted or of any form whatever, as are constantly being met with in the foundry, it is necessary that it can be made quickly and well, also that this be done in the foundry and that no adjustment be required.

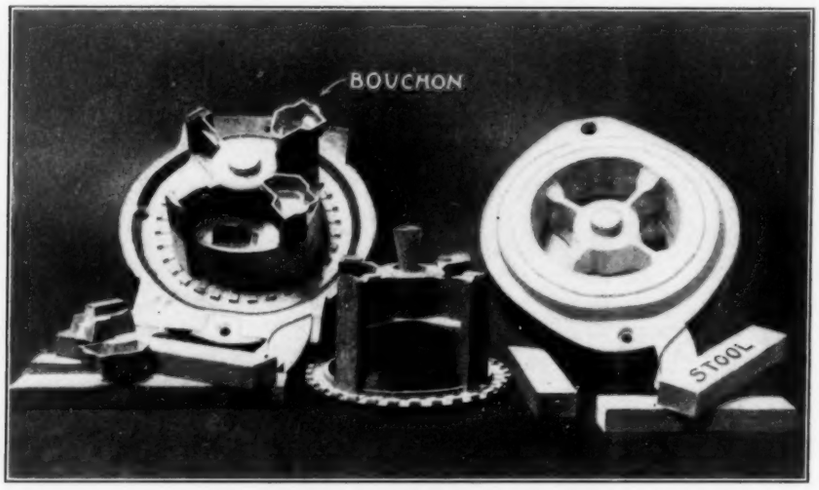

FIG. 26. DYNAMO SPIDER, WITH PATTERN PLATES, ETC.

FIG. 27. EXAMPLES OF WORK MADE BY THE DOUBLE PATTERN PLATE PROCESS.

It is claimed for the Bonvillain system that all these conditions have been met. The stripping plates are, in that system, made entirely of non-shrinking white metal, which is done by the molder without more than a few hours' expenditure of time.

In Fig. 14 the stripping plate is shown on the right; in this case it is entirely flat and carries the gates which connect to the flanges of the valves and are united in the center with the inlet gate.

In Fig. 15 is shown a stripping plate a little more difficult to make, for the pattern plate for motor-cycle cylinders. The stripping plate is, of course, the piece in the center of the picture. In this case, one portion of the stripping plate forms the parting surface, another portion serves as part of the pattern, and still others form core-prints.

Fig. 23 shows a stripping plate, part of which is very simple, another part simply following the outline of the pattern.

These few examples suffice to show what part the judicious employment of the stripping plate is able to play.

FIG. 28. EXAMPLES OF WORK MADE BY THE DOUBLE PATTERN PLATE PROCESS.

THE REVERSIBLE CLICHE PROCESS.

The word *cliché* means a stereotype plate, and the process to which they have applied the name *clichage* makes use of pattern plates with which are incorporated half-patterns of several small pieces, giving a certain resemblance to the printer's stereotype process. The result as employed in the molding machine is similar to that obtained by fixing split patterns on to a

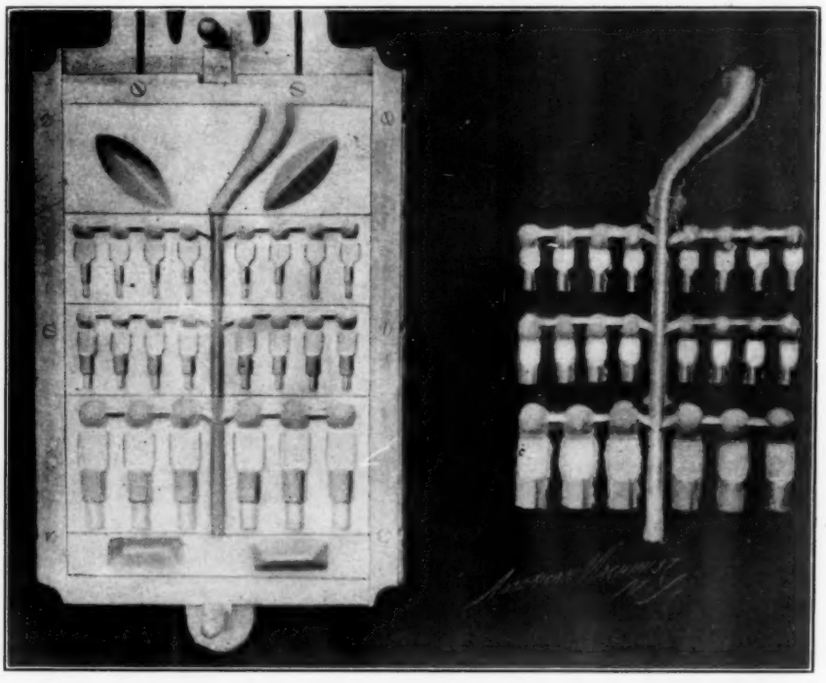

FIG. 29. CLICHE TABLE WITH CLICHES INSERTED READY FOR MOLDING, AND GROUP OF CASTINGS MADE THEREFROM.

plate, but the Bonvillain process possesses several advantages over this method.

In the first place, the kind of pieces molded in the flask may be readily varied at will, forty times in the course of a day's work if it is necessary, thus allowing of the instant execution of important jobs,

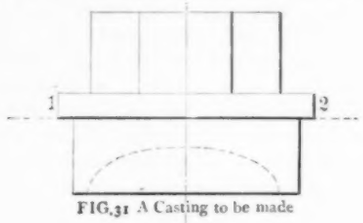

FIG. 31 A Casting to be made

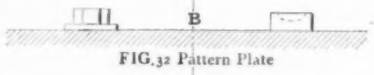

FIG. 32 Pattern Plate

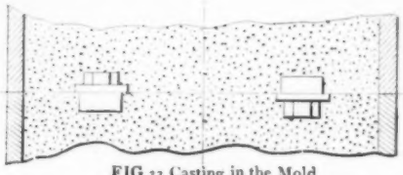

FIG. 33 Casting in the Mold (Gates not shown). *American Machinist*

or of jobs requiring only a few pieces. Then the cost of the *cliché* is but a few cents, consisting merely of a little white metal, which can be used over and over, and from one-half to two hours' work by the molder. Finally, the complete mold is obtained from one molding machine, space is perfectly utilized and the work is obtained with absolute precision, at the first stroke and without hesitation.

In this process instead of using a pattern plate of the size of the molding machine, a frame called a *cliché* table is used, into which are inserted sectional pattern plates called *clichés*. These pieces are uniform in dimension in one direction, being equal to the width of the table; in the other direction they are of a size suitable to the piece which is formed from them. A *cliché* table can be seen in Figs. 29 and 30, in which can also be recognized the separate *clichés*, each having formed on its surface a little group of patterns. The *clichés* are retained on the table by two side bars which rest in rabbets formed in the *clichés*. To remove a *cliché* and replace it by another, the side bars are readily removed, the *cliché* lifted out and another put in its place. The plates are grooved, which permits of assembling together *clichés* of varying lengths. It is easy to see that this feature enables a considerable number of different jobs to be executed on the machine during the same working day.

In explaining this reversible system we will take, as an example, the pattern of a hexagonal plug, Fig. 31.

Suppose that the parting surface comes on the line 1—2 and that we are able to dispose the upper and lower parts on either side of an axis *B*, Fig. 32, being equally distant from it on the same pattern plate. By successively making two exactly similar flasks from this pattern plate and then closing one upon the other so that the two axes *B* exactly coincide, we obtain the result shown in Fig. 33, being two imprints of the same piece, the one having the hexagonal part above, the other the hexagonal part below. The enormous advantage which results is evident: one can make the complete mold with one pattern plate, and consequently with one machine.

Another advantage is in the case of pieces having a side nearly flat, as in Fig. 34; in that it is possible to mold the pieces side by side, instead of having to leave a large space between them, as in Fig. 35, which is required by the non-reversible system. In certain cases it is possible to economize 25 to 30 per cent. of the surface of the mold by this means.

The whole question lies in the preparation of the pattern plate; this is made of white metal, which has no shrinkage, thus permitting of starting with an ordinary pattern as used for hand molding. With

FIG. 34 Reversible System

FIG. 35 Non-reversible System

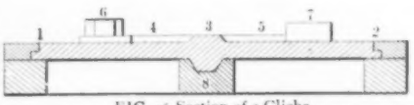

FIG. 36 Section of a Cliche *American Machinist*

this pattern they make a first mold very carefully, with a special very accurate flask and a very fine special sand, and by various combinations they obtain a plate (Fig. 30) having a uniform width and thickness, rabbets 1 and 2, Fig. 36, a central gate, and branch gates 4 and 5, the upper and lower parts 6 and 7 of the pattern, a guiding tongue 8, and a length depending upon the patterns under consideration. Some of the *clichés* are shown loose in Fig. 30, two of them being upside down.

The *cliché* thus obtained is carried in a table, the form of which is clearly shown in Fig. 29; it being made with great exactness.

The special flask and the table being given, the formation of the *cliché* consists of an ordinary molding operation with special sand.

The *clichage* process permits the mold

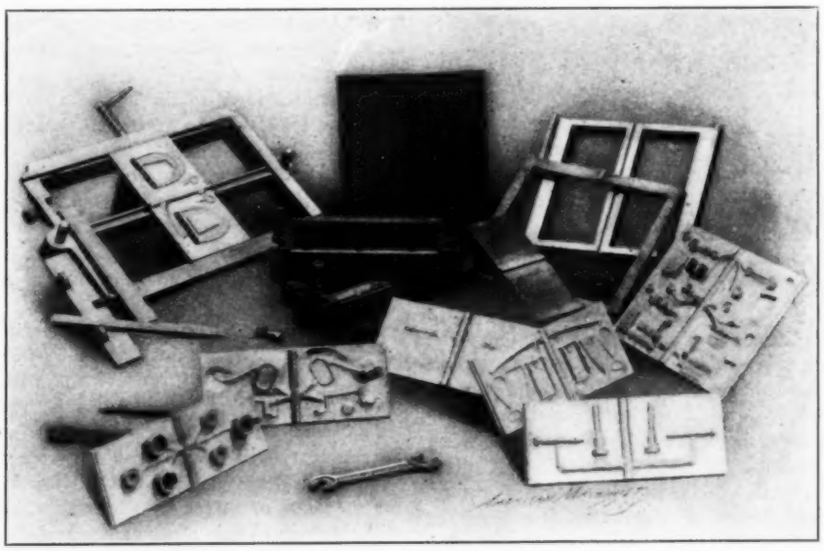

FIG. 30. OUTFIT FOR MAKING REVERSIBLE CLICHES AND SOME CLICHES COMPLETED AND READY FOR WORK.

FIG. 37. CLUSTERS OF CASTINGS MADE BY THE CLICHE PROCESS.

being cast on end as in Fig. 37, or flat. It is advantageous for small pieces to have two inlet gates feeding at a time, as otherwise the metal would not be able to reach the pieces most removed from the center.

APPLICATION OF THE REVERSIBLE SYSTEM TO LITTLE PIECES WITHOUT CLICHAGE.

For orders of great importance for which there is occasion to fill a flask with duplicates of the same piece, they employ different processes. First one can make similar *clichés* and place them side by side in the receiving table; the readiness with which this can be done is evident from Fig. 30. This is sometimes most advantageous.

In other cases, they make a pattern plate which contains only one kind of pieces, as

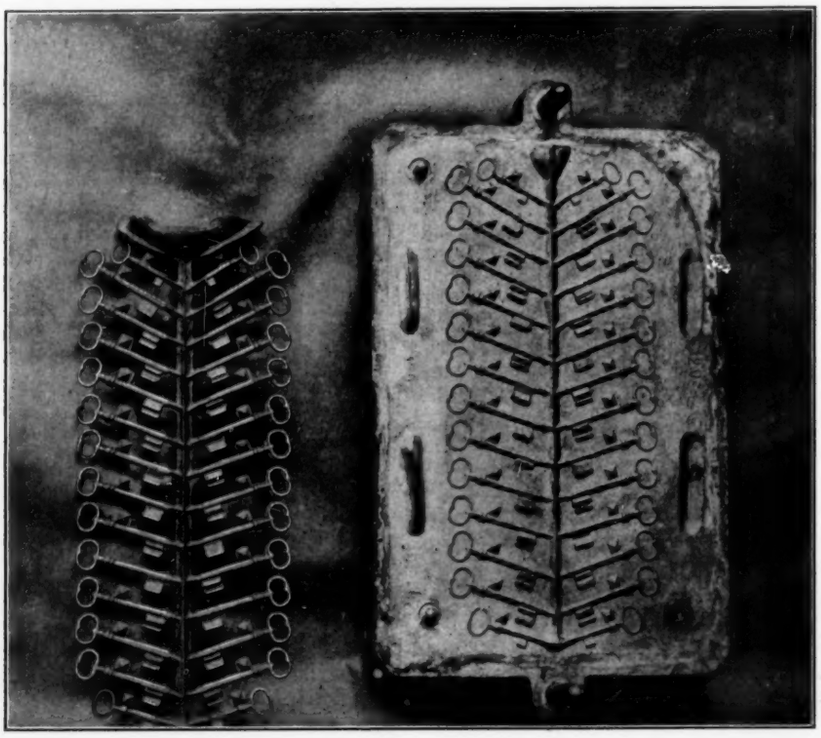

FIG. 38. BUNCH OF KEYS MADE BY THE REVERSIBLE SYSTEM NOT USING CLICHES.

in the case of the keys in Fig. 38, which are malleable castings. This pattern plate is made entirely of a special quality of plaster, of which the surface is hardened by a suitable process. Such work as this is cast in a vertical position in a press; as the accuracy of the flask alone is not sufficient for work of this kind, metallic guides, male and female, are placed in the mold during the ramming of the sand.

Another application of the process consists of making the pattern plates of restricted dimensions for the little pieces. This is particularly suited to pouring in a horizontal position, for in this case the metal more readily reaches the pieces, as the pieces most distant from the central entry gate are not very far off on account of the restricted dimensions of the mold.

Vanderlip on Schools for Artizans.

Frank A. Vanderlip, ex-Assistant Secretary of the Treasury and vice-president of the National City Bank, of New York, in a lecture on "The Economic Importance of Trade Schools" at Cooper Union, December 13, said, in part:

The industrial life of this country has in a decade undergone changes more significant than have been encompassed before in two generations. There has been combination in the field of labor, as evidenced in the growing power of unionism; combination in the domain of capital, as manifested in the trusts; concentration in the control of industries, in the subdivision of labor and the aggregation of wealth. This display of the forces of combination has brought changed conditions into the problem of human industrial endeavor. The welfare of the people and the position which our country is to maintain among nations, both depend on no single thing more than on the recognition of these changed conditions by our educators. They must recognize the new demands of the times. They must provide the educational requisites which these changed conditions make imperative.

The forces of combination are united in a tendency to make of a great percentage of our population, commercial or industrial automatons without diversity of skill, without an understanding of principles, and without a breadth of capacity. There is but one power that can counteract that tendency—that power is the schoolmaster. These youths who can gain from their daily work only that narrow routine technical experience, which, in the main, is all that the conditions of modern industry offer, have a right to demand something more. They have a right to demand the opportunity for a practical education.

The mental equipment of a business man needs to be greater to-day than was ever before necessary. Just as the sphere of a business man's actions has broadened with the advent of rapid transportation, telegraphs, cables, and telephones, so have the needs of a broad understanding of sound principles increased. New forces have made possible large-scale production, and we need men who can comprehend the relation of that production to the world's markets. There has been introduced such complexity into modern business, and such a high degree of specialization, that the young man without the foundation of an exceptional training is in danger of remaining a mere clerk or bookkeeper.

I am perfectly convinced that Germany's industrial successes and the comparative contentment of her population are in a very large measure due to her system of trade schools. Now I want to leave no confusion in your minds as to just what I mean by these trade schools I do not mean the addition of manual training to the course of the public schools; that may or may not be wise, but the decision of that question has no bearing whatever on the sort of schools I have in mind. I do not mean the establishment of schools to teach young men trades. I know that such schools have been open to much criticism from practical workers and will meet much opposition from labor unions.

I recognize force in the hostile attitude of organized labor in regard to schools designed to teach trades. Their point of view may be somewhat selfish, but it is perfectly human. I do not mean, either, that we have any lack of higher technical schools. I think we are fully abreast of the rest of the world in the facilities we offer for training our captains of industry.

It is the rank and file that I am considering, the privates of the great industrial army who have gone forth to the daily grind of work, taking with them such mental equipment as our school system has been able to give to youths of 14 or 16 years. I believe we need to establish for the members of this army a means which will aid them to gain a supplementary education along lines particularly adapted to their requirements.

A recent visitor to the works of the Builders' Iron Foundry, Providence, R. I., found them exceedingly busy, building among other things, a number of the D'Auria pumping engines, the ingenious invention of an Italian engineer, described and illustrated by us a few years ago, and using a confined reciprocating body of water as a fly-wheel.

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Studies in Inventive Problems—XIII.

Proposed by Leicester Allen and Solved by Various Readers.

We shall be wholly occupied with solutions of Problem V in this number of the series, except that I shall state another problem, VIII. I am gratified by the number of solutions received, which exceeds my anticipations. I did not consider this problem as a very simple one, and the solutions received indicate that gray matter is not lacking in the thinking machines of the solvers. I feel justified in the opinion that these solutions evince a highly creditable degree of inventive and constructive talent.

I am in receipt of a personal letter from a gentleman now occupying a high position in an establishment constructing fine machinery, in which letter he makes a statement which affords me much pleasure. He says that the study of problems proposed by me in the AMERICAN MACHINIST, was the cause of his discovery that his proper career was that of constructive mechanics. He had previously never given any particular attention to the subject, having been reared on a small western farm. The inspection of one of his solutions by a proprietor of a medium sized machine shop in a neighboring town, was the means of his securing an engagement therein at a wage of three dollars per week. This was the beginning of what he modestly styles "moderate success," which in the lapse of years has gained him his position of mechanical superintendent of an important department, at a salary he never dreamed of realizing at the time he made his three-dollar-a-week start. I am prohibited from stating further details by his desire not to have his name mentioned. I can assure readers of this series that a letter of thanks from a man of this class exceeds in value any pecuniary reward of technical literary work. To any right-hearted man the assurance that he has done some good in his day and generation is a recompense or much of the care and disappointment which human life entails.

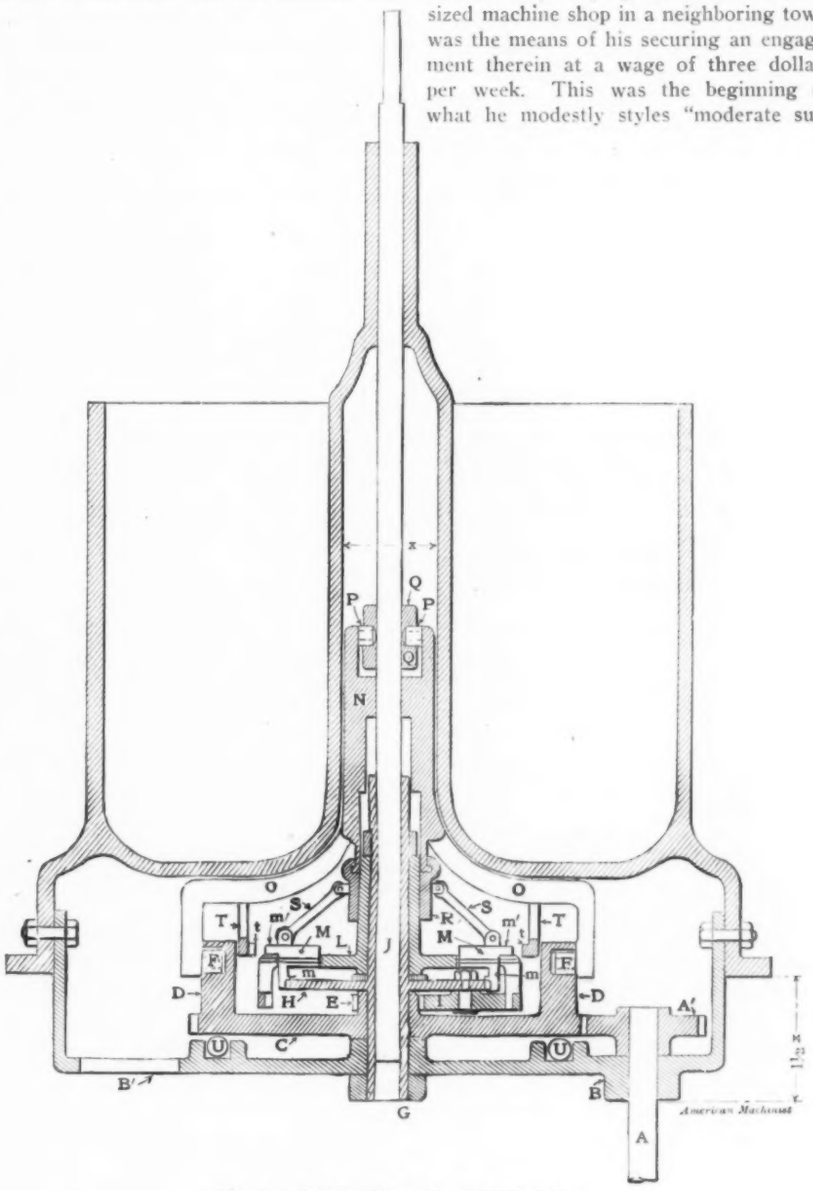


FIG. 1. SOLUTION NO. 2. TO PROBLEM V.

PROBLEM V, SOLUTION NO. 2, FIG. 1. J. MELANCON, AMITE, LA.

Mr. Melancon's solution came to hand second in order; Carl J. Ulmann's, published at page 773, being the first received.

"The accompanying drawing shows a vertical central section, but all dotted lines and lines connecting extremities of sectional parts have been omitted for the sake of clearness. *A'* is a pinion keyed to the end of vertical shaft *A* which comes up through the ceiling, passing through diaphragm *B* which forms a bearing for it, and a support for the rest of the mechanism. This diaphragm contains a number of holes, as shown at *B'*, of a convenient size to admit a man's hand for the purpose of inserting the bolts by which the diaphragm is fastened to the base of the receptacle. The lower end of spindle *J* just clears the ceiling when in its lower position. The long sleeve *G* is an easy fit on spindle *J*, and is keyed to it in such a manner that this spindle is free to move vertically, but can only revolve with *G*. Fitting loosely over *G* is a large gear wheel *C*, pinion *E* and cylindrical cam *D*, all three of which are cast in one piece or otherwise rigidly connected. A casting *N* fits loosely over the spindle *J* and sleeve *G*, and is prevented from turning by vertical ridges cast on the inside of the hollow column, which ridges fit into grooves on the surface of the casting; but it derives a vertical motion from cam *D* through the rollers *F F* and arms *O O*. This vertical movement it in turn communicates to the spindle by means of two rollers *P P* at its upper extremity, which revolve between the two collars *Q Q* fastened to the spindle. *H* is a plate cast together with, or otherwise connected rigidly to, sleeve *G*, and carrying a small gear *I* which meshes with pinion *E*. The edge of plate *H* is serrated around its entire circumference with shallow 60-degree teeth. *L* is a casting, also a loose fit upon the sleeve *G*, and has teeth upon its inner circumference, thus forming an annular gear which also meshes with *I*. *M M* are slides in grooves in *L*, and each carry two stops *m* and *m'*. When in the position shown, stop *m* engages with the serrations in the edge of plate *H*. The lower part of the casting *N* forms a shoulder which fits loosely within a sectional collar *R*. The vertical motion of *N* thus operates slides *M* and *M* through collar *R* and links *S S*. When the slides are in their outer position *m'* engages with serrations *t* in the edge of *T*, which is a sectional diaphragm made in two parts or sections, so as to go over the arms *O O*, and so bolted to the base. The slides *M M* are so proportioned that stop *m'* engages with the serrations in *T* at the

moment stop *m* releases *H*, and *vice versa*. The action is as follows: Shaft *A*, revolving, causes *C* to revolve, and the groove in cam *D* is designed so as to impart to *F*, *O*, *N* and *J* a vertical movement of ⅓ *x* during each half revolution of *C*. This would, by means of *R*, *S* and *M*, give this result; during a quarter revolution of *C*, *E I L* and *H* would be locked together and the spindle would revolve at the same rate as *C*. During the next quarter revolution, *L* would be locked to the stationary diaphragm, and *I*, *H* and *J* would revolve, but at reduced speed. Suppose *E* to have 20 teeth and *L* 60 (number of teeth in *I*

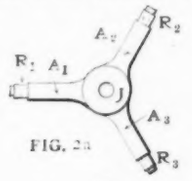


FIG. 2a

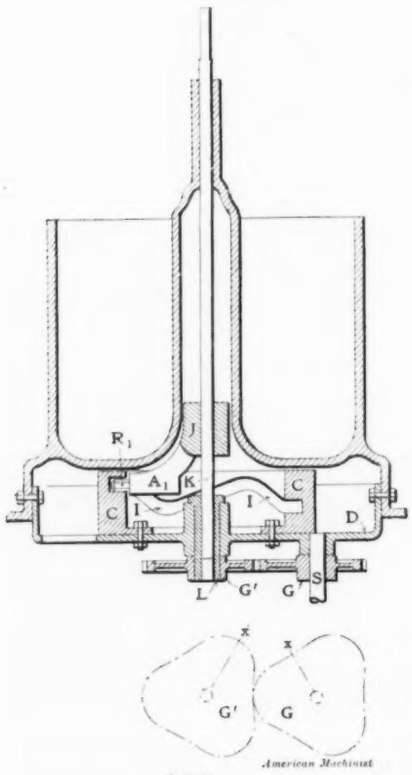


FIG. 2
SOLUTION NO. 3 TO PROBLEM V.

is immaterial). During that quarter revolution in which *E*, *I*, *L* and *H* are locked together *J* would, of course, make one-quarter of a revolution. During the next quarter, in which *L* is stationary, *I* will advance along as many teeth of *L* as there are teeth in one-fourth of the circumference of *E*—that is, five teeth. But five teeth is only five-sixtieths, or one-twelfth, of the circumference of *L*; *I*, *H* and *J* will therefore advance only one-twelfth revolution. Now, since one-fourth plus one-twelfth is one-third, it is obvious that *C* will have to revolve one and one-half times in order to have *J* make one revolution, and during this time *J* is made to rise and fall three times, according to the terms of the problem. At *U U* is shown a race in the diaphragm *B* and balls to take up the weight of the cylindrical cam and superincumbent parts."

While I think this device would produce the desired movements in accordance with the conditions of the problem, it is open to criticism on the points of complicated construction and the weights of moving parts. I also think that it could not fail to be unduly noisy in operation. The reciprocating parts moving at the velocity required and coming to full stop, while transmitting their living force to the slides *M*, must cause the latter to hammer on the stops described. As the weight of the sieve and its contents is small, it is probable that the parts could be made light, but I do not think they could be made light enough to obviate objectionable noise in working. I doubt also that they could be practically designed so as to work in the limitations of space set forth in the enunciation of the problem. The solution, however, displays much ingenuity.

PROBLEM V, SOLUTION NO. 3, FIGS. 2 AND 2a.
J. MELANCON, AMITE, LA.

Mr. Melancon contributes another solution, to which the above criticisms are not applicable. In this solution complexity is replaced by extreme simplicity. I regard it as a much superior device to that presented in Solution No. 2. It will be seen that the variation in velocity of rotation of the spindle is gained by the use of lobed gears *G*, while the vertical motion is secured by a stationary cam *C*, in the groove *I* of which work rollers *R* on the extremity of three radially projecting arms *A*, centrally attached to the spindle at *J*, Fig. 2. These arms are shown in plan in Fig. 2a. The driving shaft *S* is shown in Fig. 2. Although Mr. Melancon has supplied a more elaborate description, I think no one will be at a loss to understand his mechanism from the condensed description I have here presented.

To Mr. Melancon's description of the operation of this mechanism is appended a query, whether, in his two solutions, the omission of the joint at the lower end of the spindle in the drawing accompanying the statement of the problem, will be regarded as invalidating his solution. I answer that, as this joint was a feature of my own solution and not an *essential* feature, its omission is of no moment. I am trying to conduct this series of articles on liberal principles, and therefore shall not split hairs or insist on trivial technicalities.

"The movement in Solution No. 3 is as follows: Shaft *S*, driven from below, carries *G*, which drives *G'*, rotating sleeve *L* and spindle *K*. Referring to the diagram

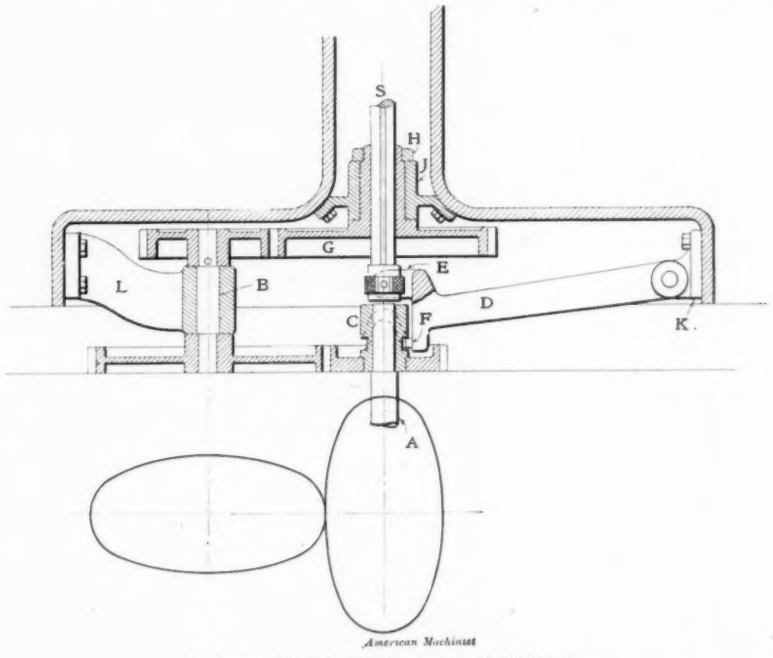


FIG. 3. SOLUTION NO. 4 TO PROBLEM V.

of lobe wheels, which represents the pitch lines of the gears *G* and *G'* when in mesh, it is evident that if *G* is driven at a uniform speed, the speed of *G'* will be changing continually. For instance, when the gears shall have rotated 60 degrees from the position shown, teeth at *x* and *x* will be in contact and the rotative speed of *G'* will be lower than when in the position shown. As the spindle rotates, carrying *J* with it, the rollers on ends of arms follow the grooves in the stationary cam and cause a vertical movement of the spindle equal to the extreme difference in the height of center line of groove, which vertical motion takes place three times during each revolution of the spindle, as required by the terms of the problem."

PROBLEM V, SOLUTION NO. 4, FIG. 3. GEO. D. HAYDEN, NEW BEDFORD, MASS.

Mr. Hayden uses elliptical gears for gaining the required variation of velocity

in the rotation of the spindle, a method analogous to that adopted by Mr. Melancon in Solution No. 3. But he employs different means of effecting the vertical reciprocation. His description follows:

"On the driving shaft *A* and on stud *B* are mounted a pair of equal elliptical gears. A uniform motion of the driver will impart to stud *B* a gradual acceleration up to a maximum, then a gradual decline to a minimum. This will occur twice in every revolution. Now, gearing from stud *B* to shaft *S* with ratio of one on the stud and one and one-half on shaft *S*, the shaft *S* will receive the motion of rotation desired—a gradual and alternate fast and slow motion complete in every third of its revolution; for one-half divided by one and one-half equals one-third. On the driving shaft *A*, above the elliptical gear and fast thereto, and also fast to the shaft, is cam *C*, provided with a rise and fall in each half of its circumference, thus imparting to the shaft *S*, through the lever *D*, a complete up-and-down motion during each third of a revolution of *S*. Elliptical gearing is not very popular in machine design; but it would seem to be the proper thing here rather than a more highly organized design. The lever *D* is forked at *E* and is provided with the regulation bronze ring with looseness to compensate for the foreshortening due to the arc. *F* is a roll engaging with the cam. The spur gear *G* is held in position by the collar *H*, and is provided with a key that has a sliding fit in shaft *S*. The brackets *J*, *K* and *L* are securely fastened to the body or frame."

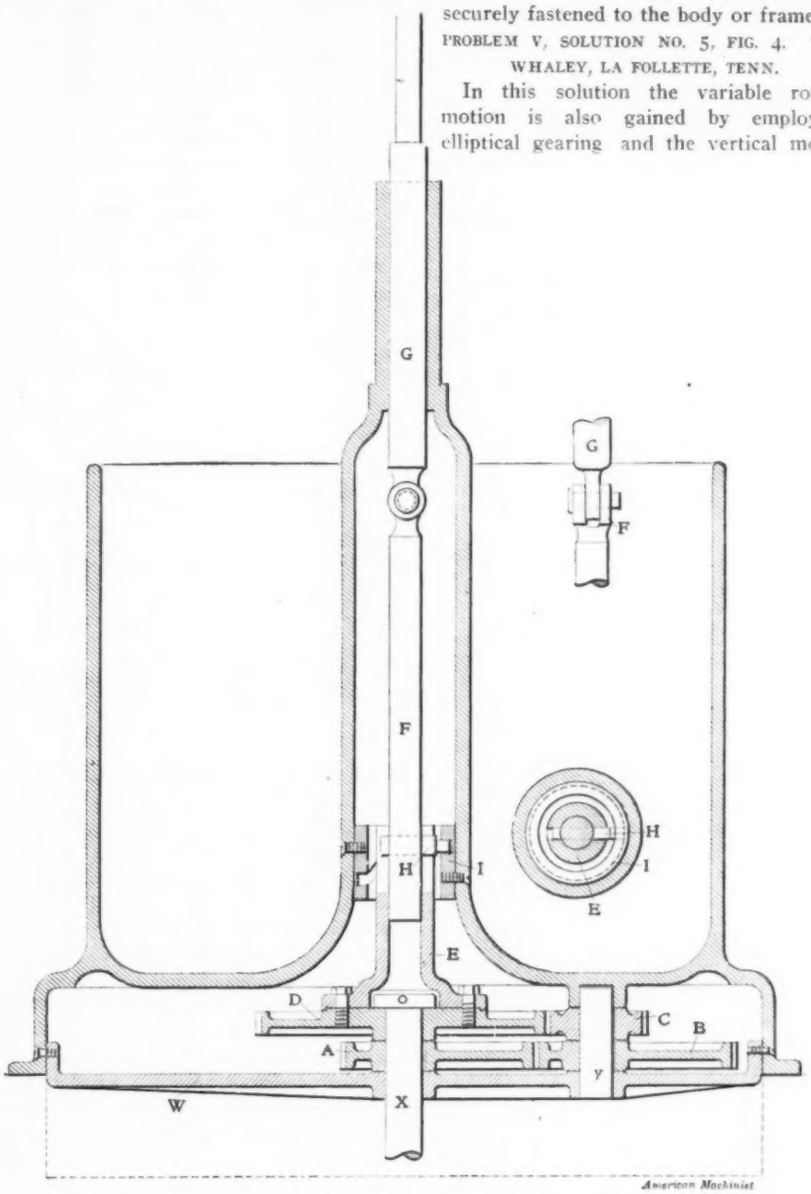


FIG. 4. SOLUTION NO. 5 TO PROBLEM V.

PROBLEM V, SOLUTION NO. 5, FIG. 4. WM. WHALEY, LA FOLLETTE, TENN.

In this solution the variable rotary motion is also gained by employing elliptical gearing and the vertical movement is generated by a cam, but these elements are differently combined. I think the use of a cam of so small a diameter as is compelled by placing it in the hollow central column, is a feature that would be found difficult to make practically operative, as the alternate rise and fall of the groove would of necessity be very abrupt; but in his description, quoted below, Mr. Whaley suggests other means of producing the required vertical motion.

"In the drawing, *G* is the spindle to which is to be imparted the prescribed motion, namely, an average rotative speed of sixty turns per minute, to be accelerated from a minimum to a maximum during the first half of each third of rotation, and retarded to a minimum during the second half of each third of rotation, while the spindle *G* is to be moved vertically up and down a distance of $\frac{x}{3}$ inches during each third of rotation.

"*A* is an elliptic gear keyed to vertical shaft *X*. *B* is its mating gear keyed to shaft *y*. The gears may have any desirable ratio of axes and transmit a variable speed of rotation to *y*. *A* runs at 180 revolutions per minute. *B* runs at the same average velocity, varying from minimum to maximum and back each revolution. The spur pinion *C* is also keyed to *y* and drives spur gear *D*, loose on shaft *x*. On hub of *D* is bolted a sleeve *E*, in which a rod *F* has a sliding fit, being free to move up and down, but constrained to rotate with *E* by the key *H*, which slides up and down in slots cut in *E*. Key *H* has a rounded end which projects into a cam groove in bushing *I*, said groove imparting to the spindle *F* the required vertical movements. Pinion *C* is one-third as large as gear *D*; hence the variable motion of *C* due to the elliptic gears is repeated in each third of a rotation of *D*, and imparted to *F* and *G*. The bottom bracket *W* supports shafting, gears, etc. The construction of the several parts is clearly shown in the drawing. If preferred, spindles *G* and *F* may be given the vertical motion by a system of rock levers and rods driven from a crank-pin on pinion *C*; but in such case the space between the floor and ceiling (shown in dotted line) would have to be utilized."

PROBLEM V, SOLUTION NO. 6, FIGS. 5, 5a, 5b AND 5c. F. W. BACH, ILION, N. Y.

Mr. Bach resorts to mutilated gears to obtain alternate acceleration and retardation in the rotation of the spindle. I cannot see that in this way a gradual acceleration and retardation is possible with a uniform motion of the driving shafts. If the motion of the driving shaft be approximately uniform, the velocity of rotation of the spindle and the sieve will change from minimum to maximum velocity almost instantaneously, with shock to the machine and noise generated by the shock; so that I should anticipate a very uncomfortable working machine designed on these lines. But as with the exception noted it will, so long as it holds together, give the motions required, I herewith present it. Fig. 5 is a central, vertical section. Fig. 5a is a plan. Fig. 5b is a partial vertical section, showing the parts in a different position. Fig. 5c is a plan

view of gears showing details of construction. Mr. Bach has supplied also two other drawings, one of which is a group of details (which I think are not necessary to a full understanding of his solution), and the other a layout of the cam by which vertical movement is attained. Such a layout is so simple a piece of draftsmanship that I think it is not needed. Mr. Bach thus describes his device:

"I have added two castings to the base of the main casting as presented by Mr. Allen. Casting *P* can simply be a circular plate bolted to the lugs *D*, placed on the inside of the base *B*, or it can be a four-armed spider with the arms of the same width as the lugs *D*. The casting *R* can be made as a pan, and bolts run through holes in *P* and *D*, making one set of bolts do for the whole bottom. Two collars *L* keep the driving shaft *E* in place. The shaft *E* drives the two complete gears *I* and *J*, which are fastened together, and these gears mesh into two other gears *G* and *H*, which each, on the alternate one-sixth of the circumference have the teeth cut wholly away below the bottom of the teeth, and are also fastened together so that as gear *I* begins to mesh with gear *G*, the gear *J* is just leaving the mesh of gear *H*, causing the two gears *G* and *H* to be accelerated to a maximum when *I* is in mesh with *G*, which would be the first half of one-third of the rotation, and retarded to a minimum when *J* is in mesh with *H* during the last half of one-third of a rotation. The two gears *G* and *H* drive the shaft *S'*, which is free to slide on two splines *F* up and down inside of the hollow column *C*. The shaft *S'* has at its lower end a cam *M* with a groove in its outer face, or rather its circumference, which has a rise and drop three times in its circumference. Two posts *N* fit close to the cam *M* and contain on opposite points a screw *O* and set-nut *T*, the screw having a hardened roller on the end which enters the cam groove of *M*, causing the shaft *S'*, and by the joint between *S'* and *S* the spindle *S*, to move up and down during each one-third rotation."

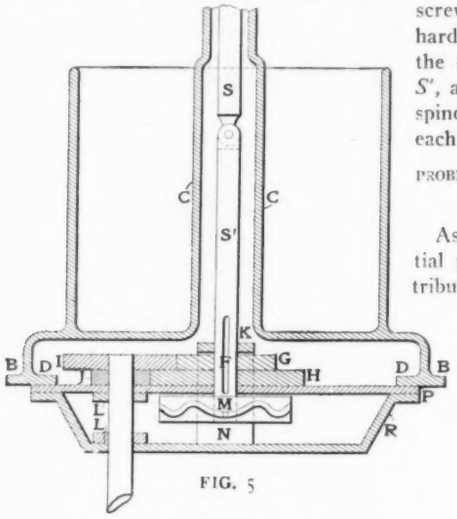


FIG. 5

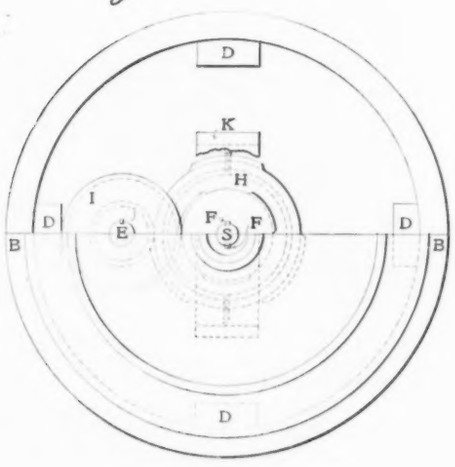


FIG. 5a

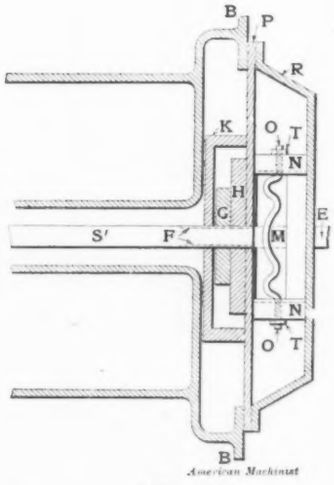


FIG. 5b

SOLUTION NO. 6 TO PROBLEM V.

PROBLEM V, SOLUTION NO. 7. E. C. NOBLE, ROCK FALLS, ILL.

As this solution corresponds in all essential particulars with solution No. 3, contributed by Mr. Melancon, it is necessary only to refer to that solution to understand it. But Mr. Noble asks the following pertinent question:

"Pardon me if I inquire why the hand-sifting motion would not be better imitated by a reciprocating rotary motion along with the reciprocating vertical motion, instead of a continuous rotary motion? Such a combination would be much easier obtained than by Problem V."

I consider this question well worth an answer. When I undertook the solution of the problem (which, by the way, I worked out without employing lobe wheels, elliptical gears, cams, rock levers or bell-cranks) it may be supposed that I first made a study of the motion of the sieve, as operated by hand, not as used for other purposes, however, but as used for sifting *the particular material* which my device was to operate upon. I reasoned that hand movement in sifting would vary according to the nature of the materials to be sifted. Some material will almost run through a sieve when poured in. What is a filter but a sieve for separating liquids from solids? Most filters operate without any movement of the filter. Others require gentle shaking to keep their interstices from clogging. At the other extreme there are materials that will sift only very sluggishly through a fine mesh except by constant rubbing of the material by the hand or by some instrument used for rubbing. So I studied first the sifting of the material with which I had to deal, and I found that all the people engaged in the work ultimately acquired a movement which I will try to describe. They lifted the sieve with both hands, at the same time turning it about one-sixth of the way around. Second, they moved the sieve downward, at the same time throwing the sieve around in the same direction as before. This rotary motion was effected by an impulse imparted to the rim by the hands whose hold was loosened to allow the inertia of the sieve to spin it around through the arc of revolution. Now, as I had been assured this hand sifting had been the only thing up to date that did the work in a satisfactory manner, I saw my work cut out before me, to imitate this motion (become a habit with the operators) as nearly as I could, the more especially as I was also assured that a practiced hand could do about twice the sifting in a day that new hands would do. Had I been contriving a machine for some other kind of sifting I might have adopted the motion suggested by Mr. Noble; but whatever the material to be sifted, I should have first studied and tried to imitate the movement acquired and executed by the more expert operators.

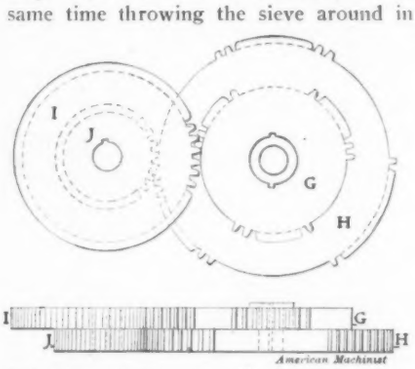


FIG. 5c. SOLUTION NO. 6 TO PROBLEM V.

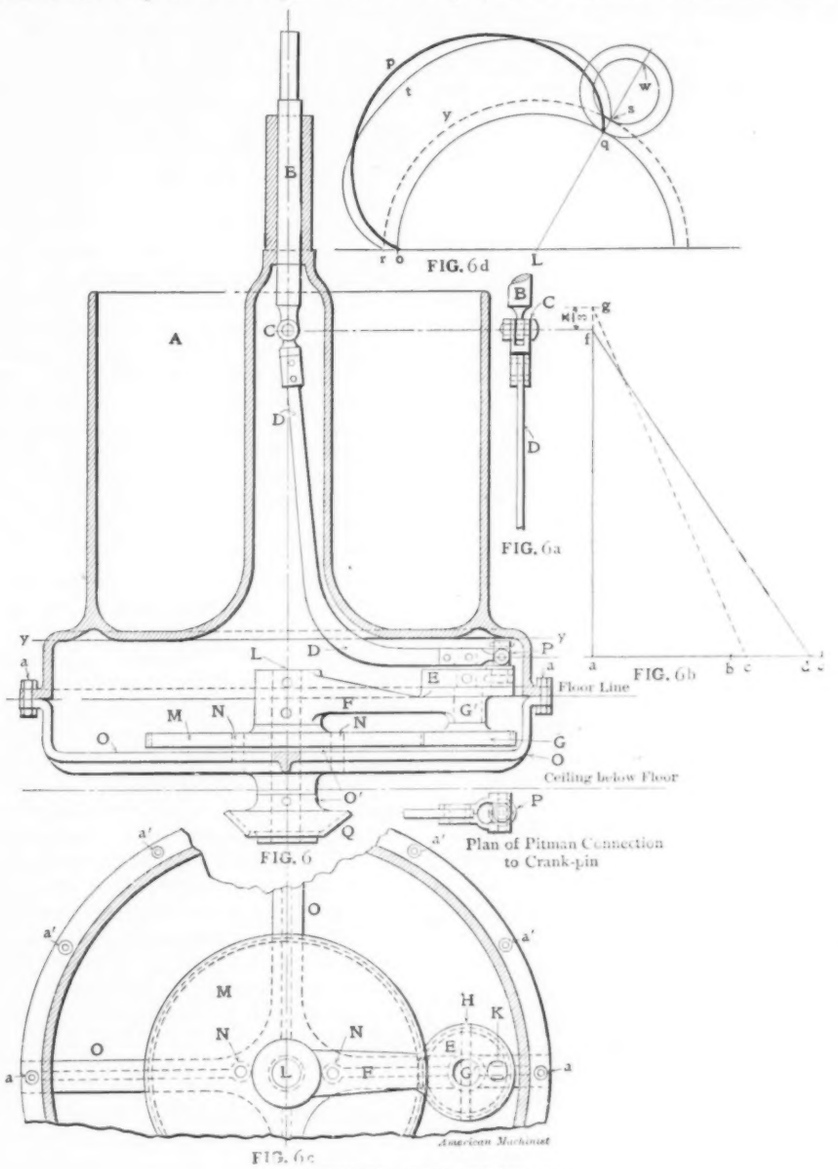
PROBLEM V, SOLUTION NO. 8. HAROLD SMITH, BRADFORD, YORK, ENGLAND.

Mr. Smith sends a clear drawing and description, which appears in all essentials

to be the same as that presented in solution No. 3 by Mr. Melancon, except that he employs elliptic gears for the lobe wheels of Mr. Melancon.

PROBLEM V, SOLUTION NO. 9. A. W. CHAPPELL, NEW YORK CITY.

Mr. Chappell also gets his alternately accelerated and retarded rotation of the spindle by elliptic gearing, and the vertical motion by the agency of a cam. I should like to present the separate drawings of all the devices designed on these lines, but to do so would be to sacrifice valuable space.



SOLUTION NO. 10 TO PROBLEM V.

PROBLEM V, SOLUTION NO. 10, FIGS. 6, 6a, 6b, 6c, 6d. LEICESTER ALLEN, NEW YORK CITY.

This solution not only secures the required movements, but it illustrates a method of obtaining acceleration and retardation of rotary motion from uniform rotary motion without the employment of lobe wheels, elliptical gears or mutilated gears. It also illustrates a method of producing a reciprocating rectilinear movement by the use of a crank and pitman, with no other intermediate mechanism, *when the line of the reciprocation is at a right angle with the plane of rotation of any point of the crank.* I might have formulated these movements into separate problems. I think they will be of interest to mechanicians and designers.

Fig. 6 is a vertical central section and Fig. 6c is a plan view and section on *y y*, Fig. 6, of the machine. Fig. 6a is a detail showing the attachment of the pitman to the rotating and reciprocating spindle. Figs. 6b and 6d are diagrams illustrating features of the reciprocating vertical motion and the variable rotary motion of the spindle.

A is the receptacle for the sifted material. *B* is the spindle. This spindle was a hollow cylinder to lessen its weight, but this feature is omitted in the drawing. To the bottom of *A* is bolted a four-armed spider *O* by bolts *a*. This spider has a central hub *O'*. To this hub is fitted a fixed spur gear *M*, held fast to the spider *O* by pins *N*. To a bearing in the spider hub is fitted a vertically rotating shaft *L*. On the lower part of *L* is fitted a bevel gear *Q* which, in use, is driven by a vertically rotating bevel gear keyed to the line shaft below the ceiling. To the upper part of *L* is pinned a horizontally rotating arm *F*. At its outer extremity arm *F* carries the crank-disk *E*, the pinion *G* and short shaft *G'*. The pinion *G* and its shaft *G'* are turned integrally from a single piece of stock. The shaft *G'* passes through a hub in arm *F*, which hub has its upper part enlarged to the same diameter as that of the crank disk *E*. Thus the entire under surface of crank-disk *E* bears upon the hub at the end of the arm. A ball bearing might be used advantageously here. The crank-disk *E* is pinned to the shaft *G'*, which latter may be considered as a stud, made integrally with *G*. *D* is a bent pitman made of a natural crook of sycamore, this wood being selected on account of its resistance to splitting. The body of the pitman was preferably made of wood to make the reciprocating parts as light as possible. As constructed, the thickness of the pitman shown in Fig. 6*a* is only three-fourths inch. The method of inserting and holding the crank-pin in the crank-disk *E* is plainly shown in the drawing. A collar with lateral pintles was fitted to slip over the crank-pin, and over this collar another collar was fitted and pinned to the upper part of the crank-pin. The tendency of the pitman to throw off from the crank-pin is very slight, as will be seen presently. The nature of the connection of the pitman to the spindle at *C* will be readily understood from Figs. 6 and 6a. The base of *A* is firmly fastened to the floor by bolts *a'*—two between each pair of spider arm bolts. By applying rotative power to *Q* arm *F* is caused to make one turn per minute as required; and, through pitman *D*, which also acts like a crank on spindle *B*, the spindle is caused to make a rotation on its axis at the same time. But the path of the crank-pin axis at *P*, for each third of the turn, is the curve *r t s*, Fig. 6d; while the path of any point of the pitch circle of pinion *E* is the curve *o p q*, this last being an epicycloid, while *r t s* is an epitrochoid. It follows that the crank-pin axis will at the end and at the beginning of each third turn be on the circle *r y s*. This circle is one having a radius equal to the radius of the pitch circle of the fixed gear *M* plus the distance *q s*, *q s* being the distance the axis of the crank-pin is set in from the pitch line of *G* projected up to the upper surface of *E*. But at the middle of each third-turn the axis of the crank-pin will be on the epitrochoid *r t q*, at a point the farthest possible from the center of *L*. The crank-pin axis is thus, during each third of a turn of *L*, caused to alternately recede from and approach the circle *r y s*, the amplitude of this motion being the distance *s w*, Fig. 6d.

This imparts vertical reciprocation to the spindle B.

To obtain the required amplitude of this reciprocation, which, according to the terms of the problem, is not to be less than one-third x inches (x inches being the internal diameter of the hollow central column in which is the bearing for the spindle B), we may proceed as follows:

Referring to Fig. 6b, let the line $a\,d$ be the horizontal distance from the geometrical center of the crank-pin (when in its outermost position) to the vertical axis of the spindle B extended downward, and make this line the base of a triangle. Also $a\,b$ represents the radius of the pitch circle of the fixed spur gear M, Fig. 6; $b\,e$ represents the diameter of the pitch circle of the pinion G; $c\,d$, the diameter of the crank-pin circle; $f\,g$, the amplitude of the vertical reciprocation of the spindle; $f\,d$ and $g\,c$, the distance between the center of the pintle at P and the center C, Fig. 6, $f\,d$ being the position of the line of centers when the spindle is in the lowest position, and $g\,c$ the position of the line of centers when spindle is in the highest position.

Let $h = a\,f$, $m = f\,g$; $l = g\,c = g\,d$, $r = a\,b$, $2\,r' = b\,e$, $2\,r'' = c\,d$, and $y = b\,c = d\,e$, since the crank-pin circle is concentric with the pitch circle of the piston G'.

Of these quantities all are determined while drawing to scale, except l, r'' and y.

Having proportioned r and r' to secure the proper number of reciprocations for each turn of the spindle, we may write the following equations:

$$l^2 = (r + y)^2 + (h + m)^2 \quad (1)$$

$$l^2 = (r + y + 2\,r'')^2 + h^2 \quad (2)$$

$$y = r' - r'' \quad (3)$$

From these equations the values of l, r'' and y may be readily obtained by algebraic rules, after the known quantities have been established.

Or a value for l may be assumed, and with l as radius and points f and g as centers arcs may be drawn cutting the base line $a\,e$, the intersections marking the locations of c and d. In some cases these points may be more widely separated than the distance $b\,e$, but this introduces no difficulty, since the crank-disk E may have a diameter greater than pinion G' whenever the reciprocation of B requires it. It will be seen that B is substantially a *rotating and reciprocating slide*.

The spindle B, the sieve supported by the spindle and the body of the pitman D, descend by their own gravity at so nearly the velocity of descent imparted to D by the movement of the crank-pin over the path $r\,t\,s$, Fig. 6d, that there is little or no tendency for the collar attached to D at P to pull off from the crank-pin. During the upward movement of the spindle the collar is pressed downward upon its bearing on E.

The entire weight of D and B, the sieve, and its full charge of material, does not exceed 6 pounds and 4 ounces. It will be seen that the reciprocating motion of B is in a plane at right angles with the plane of the crank-pin circle. By the same method a reciprocation in a plane at any angle less than a right angle may be effected. The pitman is made broader at the bend to stiffen it. The sieve, not shown, has its central sleeve fitted to the upper shouldered part of the spindle B, as was explained in the enunciation of the problem. However, to the lower part of this sleeve is brazed a hood, shaped like an inverted funnel, which hood extends downward over the upper part of the vertical bearing which B reciprocates to prevent any of the sifted material from getting in between the spindle and its bearing, while the machine is in operation.

I am in receipt of a number of solutions to Problem VII, announced at page 597, current volume, but only one for Problem VI, published at the same page. I am hoping more solutions for Problem VI will be offered. If any obscurity exists in my statement of the problem I will do my best to make it clear by personal letter to any desiring more light, if they will inform me what there is in the statement that they do not comprehend.

Problem VIII.

By what means can the steam cylinder of a slide-valve reciprocating engine, designed for a stroke of 14 inches and *making its full stroke*, with cut-off of half stroke, be made to operate with a *crank-throw of only 12 inches?* The term "crank-throw" here means the *diameter of the circle described by the crank-pin center, not the radius.* In solving this problem the valve motion need not be laid out or described, unless found essential to explaining the mode of converting the piston stroke specified into the crank motion specified. Bell-cranks and rock-levers are excluded from the construction, except such as may be needed for operating the valve or valves, and the gist of the problem lies in the conversion of a piston reciprocation of 14 inches into a crank motion of 12 inches diameter, or, more generally stated, the operation by a piston of any given stroke of a crank whose throw is less than the stroke of the piston.

I have found this problem not only very interesting, but instructive, and have worked out a method which I think would operate quite well in practice; but while solutions that will so work will be the more highly esteemed, any solution that will theoretically produce the motion will be accepted, whether considered practical or otherwise. The positions of dead points in the crank should also be clearly indicated. See definition of the term "dead-point," at page 640, of the American Machinist.

Fireproof Construction and Prevention of Casualties by Fire.*

BY H. F. J. PORTER.

The tendency in building construction nowadays, as exemplified in the paper under discussion, is manifestly in the direction of fireproof construction for the obvious purpose of the absolute prevention of fire and resulting in the protection of lives and property from such a casualty. It will, however, be many years before all factories will be fireproof, and meantime it becomes necessary to consider the best means for adoption to protect the lives and property housed in such factories as now exist and will continue to exist for a long time to come. The laws of the land and of the community in which a factory is situated require the fulfilment of certain obligations to insure such protection; but the moral responsibility which rests upon the employer of labor who assembles many people to work for him, should require him to do many things for their protection which it is evident cannot be embodied in the law. And it is evidently to his interest that every consideration should be given to effect a prompt escape from the building in case of fire, for it is the first duty of a fire department to save lives before attempting to save property; and in a case where lives are in jeopardy, attention must first be directed to their relief, and meantime much property may be destroyed.

Consequently it is desirable to arrange so that the means of promptly preserving lives are efficient, so that as soon as possible after a fire starts escape from it may be effected and attention be given to putting it out. In this connection experience shows that there are more casualties resulting from panic occurring during fire than from the fire itself, and also that panic frequently occurs simply on the alarm of fire when actually no fire exists, and on other occasions when there is a similar suggestion of danger. It therefore devolves upon the employer of labor to take such preliminary precautions that not only will his employees be able to obtain a prompt and easy exit from the building in case of fire, but also be protected from the results of panic in such an emergency or of panic due to any cause whatever.

It would be well to consider the methods now in vogue for protecting the lives of employees in the ordinary factory, of which there are hundreds in this and every large city of the country. In all of these places we find fire-buckets, in many of them sand-pipes with hose attached, and in some of them sprinkler systems, but among the factories so provided are few which have assigned the duty to certain specified individuals to use the buckets or the hose in case of fire, or to turn

*Supplementing the paper on "Reinforced Concrete in Fireproof Construction," read at the New York meeting of the American Society of Mechanical Engineers.

off the sprinkler system after the fire is out; and what is anybody's is nobody's business, especially under stress of excitement. All of these appliances can, however, become effective by the development of a regular fire corps.

FIRE ESCAPES.

The fire escapes which are supplied to buildings generally are of such construction as to be a more prolific source of, than escape from, accident. They generally consist of an iron balcony on the outside of the building at each floor, and these balconies are connected by means of ladders, the lowest balcony having its ladder detached and hung up on the building so as to prevent people from entering the building, which they might if it were permanently placed on the ground.

These ladders vary in position from the vertical to an angle of 50 or 60 degrees with the horizontal, and in order to descend people have to turn around and go down backward. In all cases of emergency, when both women and men have to descend by such means, and especially in winter weather when the iron is cold and perhaps covered with snow or ice, these so-called escapes are prolific sources of accident, especially at the lowest balcony, where, if the ladder is a long one, it is correspondingly heavy and the combined strength of several men is necessary to handle it. These men are not necessarily the first to reach the spot where it is located, and they cannot well get there after others have crowded down ahead of them. There results on such occasions a jam, accompanied by a crowding off of the balcony those who are near the opening. Many of these escapes can be improved by making slight changes in them.

It has been stated that the mortality from factory fires is very low. It is doubtful, however, if there are reliable statistics to show the results of such casualties.

Since the announcement on your program that there would be a discussion of this subject, I have taken the trouble to collect clippings on the subject of factory fires from the press of several large cities, and I find that there is a number of casualties of this kind occurring every day, involving the lives of many employees. The latter are carried from the factory to their homes or to hospitals, and their cases are subsequently lost sight of.

The fire department of this city advises me that almost daily they have a fire in a factory where they have to save lives before they can direct their attention to extinguishing flames.

FIRE DRILLS.

In a factory where I was engaged a couple of years ago, finding the conditions such that in case of a fire either within the building or in adjacent buildings it would be necessary to promptly empty the building of its occupants, I established a fire drill which, by occasional repetition, reduced the time of exit from more than seven to less than three minutes, a saving of time which in the case of a rapidly burning fire, or one involving considerable smoke, would undoubtedly have been the source of preserving many lives. Since that time I have introduced similar drills into other factories, and in every case with remarkably desirable results. Whereas, at first such a drill, owing to its association with danger, is usually accompanied by the fainting of some of the girl employees, later a habit of prompt and rapid dismissal is acquired, and all become possessed with a feeling of security, which largely counteracts the tendency toward a panic.

In one of these, a clothing factory, employing nearly 1,000 hands, both men and women, on the occasion of an altercation between men in an adjoining railroad yard one of the employees called out "fight." Mistaking the call to be "fire," a panic occurred, during which the factory was emptied, with many accidents, one man leaping from a second-story fire escape and breaking his leg. Since the fire drill has been introduced there is no tendency toward a panic. Everyone knows there is no danger, at least until the fire signal is given, and that then they will be properly taken care of.

In another factory, where 1,000 girls were engaged in making shirt waists, the appearance of a rat occasioned a stampede which did not end until many girls were injured. There have been similar occurrences since the drill has been introduced, but the girls have gone quickly to the nearest exit without excitement.

Some clippings which I have here show that panics occur where there is no danger. One from the New York *Times* speaks in its headlines of fifty girls becoming hysterical and several fainting in a shirt factory, where a newspaper blazed up from a spark from an electric motor, and that many women were trodden down in a senseless panic by the men, who were the more terrified. Another clipping from the same paper speaks of the employees of a large manufacturing plant becoming frightened by the smoke entering the windows from a burning tar pot in the street, and that in their rush for the exits a dozen were so injured as to require the attention of surgeons.

Other clippings show that danger is occasioned by the carelessness of some of the employees themselves. The New York *Herald* of November 11 speaks of 400 girls who were left locked in on the fifth story of a burning underwear factory by the watchman, who went to the corner to send in the alarm, and that many leaped into nets held by the firemen and others were taken down on the fire ladders. Still another account tells of a fire in a feather factory, where the girl employees went down the fire escapes until they reached the last balcony, where they could not handle the heavy portable ladder, and then, on account of suffocation by smoke, were carried fainting to the street

I have here, however, other clippings showing that fire drills have in similar instances saved lives. In a factory in Chicago, for instance, scores of employees on the signal of fire formed and marched from the building, which was shortly afterward burned to the ground. An editorial from the New York *Sun* speaks of the efficiency of a fire drill in a hospital and a school, where large numbers of children were in danger of destruction by fire, but quietly marched from the buildings, whereas, in two factories the adult employees were crazed with fright by an imaginary danger, and injured each other and destroyed much property in their wild flight for safety.

In many factories which I have examined at the request of the proprietors to satisfy them that they were doing all they could for the safety of their employees, I have failed to find any which in one way or another had not introduced some obstruction of the availability of their fire escapes.

Many factories give no thought to the subject after the fire escapes and fire buckets are supplied, and on one occasion the question to the superintendent, what he would do in case a fire occurred right then, was met by the amazing reply that he would think of some way to get his employees out. When pressed to think then, while he had plenty of time, of a way to do so, he was utterly unable to say how, under conditions as they existed, he would have gotten them out.

It is only by going through the maneuvers which would occur in case of an actual fire that the efficiency of the appliances and escapes can be tested. A fire drill will do this, and, once introduced, its desirability is too evident to allow it to be discontinued.

A liquid chemical compound named "zorene," discovered by a Hungarian chemist, is said to possess very remarkable properties. A piece of friable slag, after immersion in it, defied the blow of a heavy hammer. The same effect was produced on brick. Immersing substances in the compound seems to render them impervious to water, as shown by tests, in which no additional weight was observed after long soaking in water. Two pieces of steel, one of which had been soaked in the liquid, were submitted to an ammonia test equal to an exposure of five years in the air. The soaked specimen showed no effects from the ammonia, while the other was badly corroded. If these statements prove true the discovery should have considerable commercial value.

The Manhattan Automobile School, of New York, is installing foot-warmers for automobiles, which utilize heat from the exhaust, and are declared to made cold weather riding comfortable.

Letters to the Editor.

Copied Inventions.

I had no idea I was getting into such deep water when, in reply to Entropy's query, I let drop a few remarks on the ethics of shop practice and inventors. I merely wished to offer a suggestion or two, to show him that I had found his own remarks on that point interesting, and now he comes back at me, at page 787, with a request for further light on a subject that is as deep and wide as the sea—quite too deep and wide for me to fathom, though perhaps I can point out a rock or two and save someone from possible shipwreck, although Entropy is steering his course safely.

I once advanced the idea that inventors were, in one respect, like painters, sculptors and musicians; each believes he has a message for the world, and that message he is bound to deliver in spite of all obstacles. Entropy evidently does not belong to this class; he gives evidence of too much sound sense when he says that he has a family of his own to support and cannot afford to take on a lawyer's. Your Simon-pure inventor would fight to the last ditch and let his family feed itself. He would starve himself before giving up his cherished project. This is hard on the individual, and often on his family, but sometimes the world is a gainer by his sacrifice and possibly it was so intended in the general economy of things. The individual must look out for himself; Nature safeguards only the type, or species.

Legally, all men are born free and equal in this country, but we know there are no two on quite the same plane in all respects. When inventive genius and commercial genius are found in the same person, as in Edison and Westinghouse, then inventing and patenting is a profitable occupation, but seldom do the two occur together and we have reason to think some of the world's great inventors would not have been able to make a commercial success of a one-horse milk route. The definition of a patent as a license to fight is certainly an apt one, and partly for this reason it has always seemed to me that a patent is a very poor piece of property for a poor man to own. Regarding the question of getting capital interested in an invention, Keeley was a howling success, yet he was a fakir, while many a worthy inventor of a device which the world really needs and is waiting for cannot raise the funds to swing the smallest and surest scheme going. You may call this luck, fate, accident of birth, or what you will, but it is a very real and tangible quality, one not easy to acquire when naturally deficient, and its lack a great drawback to any man; but as to how far the unfortunate man who does not possess it is, on that account, entitled to trespass on the code of ethics which fits his more lucky neighbor, and to compensate himself in this way for what fate has denied him, is quite too big a question for me to tackle, yet it seems the one Entropy expects me to answer. Opinions on this range all the way from those of the highwayman who declares the world owes him a living down to the man so meek he "is afraid to say his soul is his own." Somewhere between these extremes lies the correct and proper mean, but each must find it for himself, and I question whether we can all find it at the same point of the scale.

I believe I have already spoken of the too commonly held idea that the inventor is the "whole push," while often his idea is a crude one and must needs be perfected mechanically at great expense before it can earn money for anybody. Then, too, in those cases where the inventor has brought the idea to mechanical perfection, or near it, the work of making it a commercial success is often a greater undertaking, and a far more risky one. The inventor usually emerges from the trial at least no poorer than when he went into it, while the capitalist often finds ruin waiting him instead of success. Perhaps, when we consider the differences in their risks, the fat slice that generally goes to the man of money and the lean one that goes to the man of inventive genius is not so disproportionate after all.

Like Entropy, I own up to the possession of a patent that is not working, but I am happy to say that while mine has never earned anything for me, neither did it cost me anything; another party paid the bills for the exclusive right to its use in certain lines. Neither he nor I has ever made a penny out of it, yet it was illustrated in some of the mechanical papers and received favorable comment.

When I was a boy of nineteen I invented a device that had no connection with my regular work, but was on a line I had taken up as a recreation. I did not have it patented, for it was not of wide application and I did not expect a fortune from it. I had some correspondence with several firms who could make good use of the invention and finally one in an adjoining State asked me to come to their factory, build the device into a specimen of their standard product, and gave assurance that if it was as I represented it they would pay me something for it. I went there and stayed two weeks; at the end of that time I had convinced them that my device was sound in principle, and had convinced myself that the old saw of "every man to his own trade" was equally so. They paid all my expenses, gave me better daily wages than I could have earned at home in the same length of time, and told me they would advise me later what they decided to do as to making general use of the device. They did *via* the *Patent Office Gazette*, a member of the firm patenting the same idea in a slightly different dress. Well, I admit that at the time I felt a bit sore over it, but in the light of experience gained later I have come to look back on this episode as a distinct and convincing manifestation of that Providence which is said to watch over fools.

From these and similar experiences, and general observation, I early came to the conclusion I had best confine my inventiveness to my own particular line of work, and unless it was something of more than average promise, let it go in with my day's work and take my chances on getting a fair remuneration *via* the pay envelope. I put this plan in practice a good while ago and have never had reason to regret it; it has saved me endless worry, anxiety and bitterness of mind, the almost invariable companions of the poor inventor. I am still poor, reckoning by the dollar standard, but I'm confident I'd be even poorer had I tried to patent and exploit any of my ideas, for few inventions have vitality enough to stand alone; they are valuable only in connection with some old-established article of common use.

To return to Entropy's case, it is surely singular that the man of means has not patented the invention and has no idea of putting it on the market if he considers it of any value. I have read that the Western Union Telegraph Company has long made a practice of buying up inventions that seemed likely to overthrow its present arrangements and deliberately shelving them. One can imagine conditions that might make this course seem a wise one from that company's point of view, but that can hardly be the case in the instance Entropy cites. With no knowledge of the conditions which have brought about this peculiar state of affairs I cannot hope to throw light upon it—in fact, I doubt if Entropy needs to have any more illumination. He seems to be pretty well satisfied with the course he has pursued so far and confident that he will stick to it, and isn't that enough for any man?

E. R. Plaisted.

Dixie's Noon-Hour Yarn.

Referring to Dixie's experience in making taps, as set forth at page 784, I do not know how the rest of the gang feel about it, but I, for one, wish he would tell us how his man measured a three-fluted tap with a micrometer.

Alonzo G. Collins.

I would like to have Dixie explain how Mr. Hale calipered those taps. He said at page 784 that he made the taps with three flutes. I can't understand how he could caliper a tap with an odd number of flutes in it. I hope Dixie will explain this at an early date.

H. L. Kohr.

[We have received similar inquiries from a number of readers.—Ed.]

Triple Centers for the Milling Machine.

The photograph and drawings herewith show a triple center attachment for the milling machine, on which can be cut taps and reamers three at a time; spiral cutters (up to 4 inches), end mills and twist drills can also be cut two at a time.

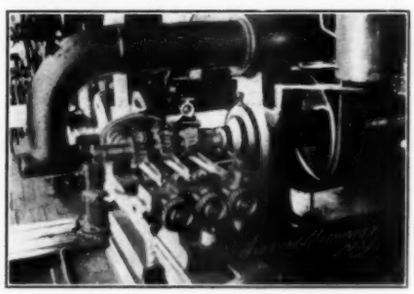


FIG. 1. TRIPLE CENTERS FOR MILLER.

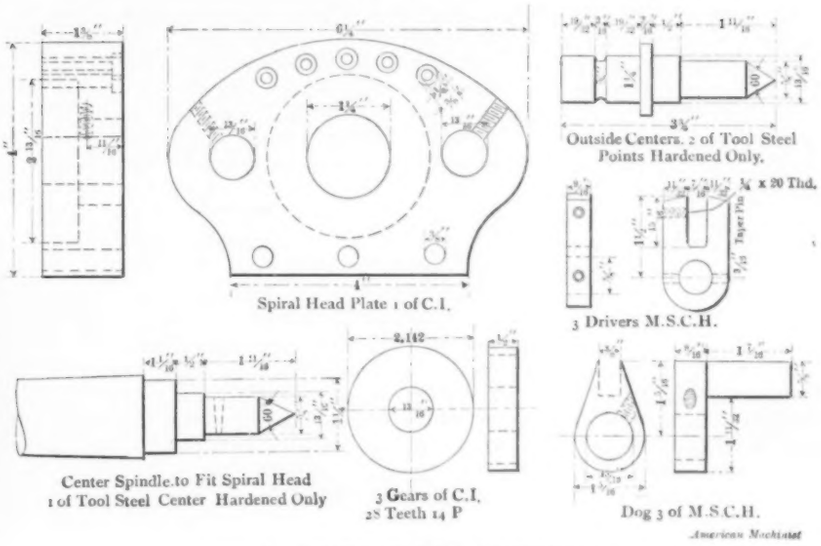

Spiral Head Plate 1 of C.I.
Outside Centers. 2 of Tool Steel Points Hardened Only.
3 Drivers M.S.C.H.
Center Spindle to Fit Spiral Head 1 of Tool Steel Center Hardened Only
3 Gears of C.I. 28 Teeth 14 P
Dog 3 of M.S.C.H.
American Machinist

FIG. 3. DETAILS OF HEAD ATTACHMENT.

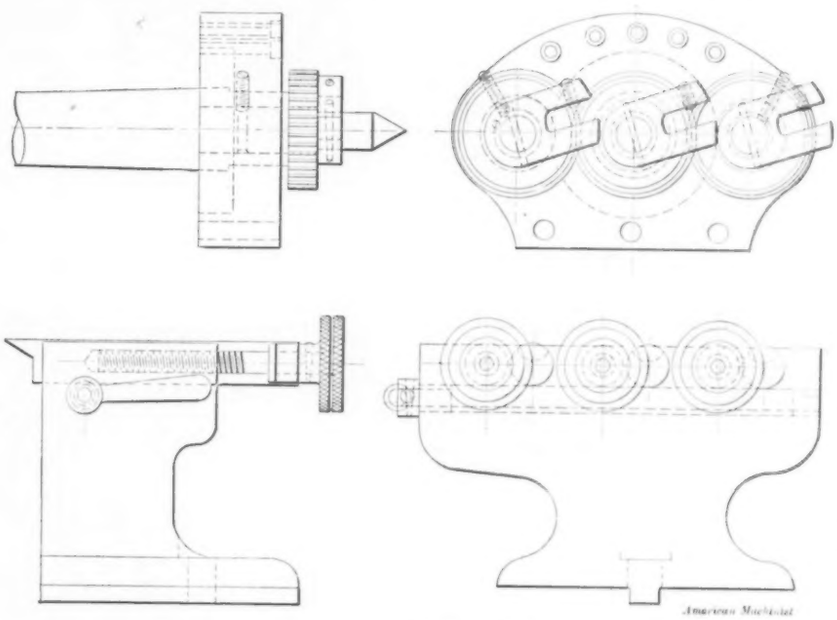


FIG. 2. TRIPLE CENTERS.

When I was given charge of the toolroom, there was only one milling machine, a No. 2 Brown & Sharpe universal, with the old-style spiral head; it was useless to ask for another machine or even a triple index center. One day I found myself up against it.; the miller had not lost a minute in the ten hours a day for three months, when I found I had a stack of eight dozen reamers (it is a locomotive shop, and they use a great many of these reamers), a few dozen special twist drills, end mills, etc., not counting twelve or fifteen spiral milling cutters; and not wanting to run oventime I studied that milling machine and the result was the attachment as shown in Fig. 1. The triple-center idea I know is not original; but this attachment, as constructed, is very simple, yet works very nicely.

To begin with, I made a gray-iron plate, Figs. 2 and 3, to be held on the spiral head by five ¼-inch fillister-head screws at the top and three ⅜-inch octagon-head screws at the bottom. The plate was recessed in the back to fit over the threaded end of the spiral-head spindle and drilled and bored for three 13-16 inch centers; the middle center was fitted to the taper hole in the spindle to act as the driver for the other two, there being a single spur gear on each. Of course, with this arrangement, the two outside centers rotate in the same direction, while the driver turns in the opposite direction. In straight milling this makes no difference, but in cutting spirals only the two outer centers can be used; also, in cutting a right-hand spiral, the reverse gear is necessary in order to give the proper direction of rotation.

The centers are two inches apart. They are provided with oil grooves and are held in place by ¼-inch 20-thread headless screws, the tapped holes also answering for oil holes. The three centers are made of tool steel and hardened on the center end only.

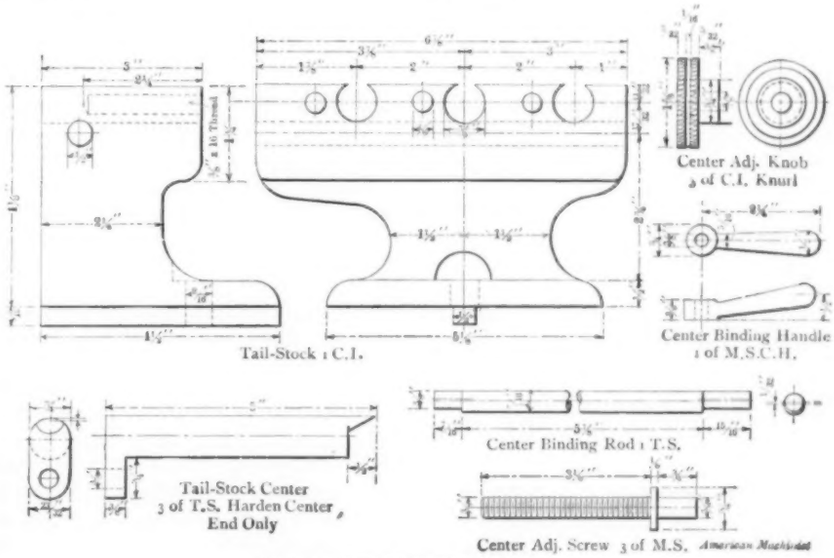

Center Adj. Knob 3 of C.I. Knurl
Tail-Stock 1 C.I.
Center Binding Handle 1 of M.S.C.H.
Tail-Stock Center 3 of T.S. Harden Center End Only
Center Binding Rod 1 T.S.
Center Adj. Screw 3 of M.S.
American Machinist

FIG. 4. FOOTSTOCK DETAILS.

The dogs by which the work is carried around, as shown in Fig. 3, have tails which fit slotted drivers and are kept steady by means of ¼-inch 20-thread headless screws; the drivers are secured to the centers by small taper pins. The whole device can be readily removed to allow the single center to be used in the regular way when desired, or when three centers will be in the way.

The tailstock centers have independent adjustments and are clamped firmly by means of an eccentric rod shown in Figs. 2 and 4. This rod runs in a ½-inch hole drilled all the way through the tailstock block, the rod itself being turned 7-16 inch on the body and ⅜ inch at the two ends, with centers offset 1-32 inch, thus giving 1-16 throw. Two steel bushings act as bearings for the rod. It is operated by a small case-hardened handle.

This attachment cost us only $24.25 to build, and when it is considered that it takes a man, getting $2.50 a day, ten hours to mill twelve reamers of the type we use on the single centers, while on the triple centers he does a dozen every four hours, it is easily seen that such a rig pays for itself in a very little while.

L. E. SALMON.

Threading Taper Work.

We have a certain piece of work, a soft-steel forging, that requires a taper thread, the diameter at the large ends being 3 inches and the taper 1½ inches per foot. This thread is cut in the turret lathe with the taper attachment, and we had no trouble with it when everything was new, but as the attachment, cross-slide and screw began to show signs of wear our trouble commenced, there being a tendency to cut the work in steps instead of on a straight taper when feeding the tool in the direction of the largest diameter. I have in other instances overcome this trouble by using springs or weights to take up the lost motion, but this method has its inconveniences. After having trouble of his own for awhile, the operator suggested turning the tool upside down, and running the machine backward. We tried it and it was a success from the start, so we have been using that method ever since, the machine being well adapted to work a tool in that position. As the scheme proved so successful on this machine I had a tool forged for use on an ordinary engine lathe, so that the inverted cutting edge was in a line with the top of the shank, and I found it to work equally well. By this method of starting the cut at the largest diameter and feeding toward the smaller end lost motion between taper attachment and slide is avoided. The lathe tool also has the same effect as a gooseneck or spring tool. It has the disadvantage that the nature of the chip on the cutting edge cannot be observed. However, the advantage of being able to observe the condition of the work without having to wait for it to make a complete turn is appreciated, especially in threading taps. I have found this method very satisfactory in finishing the soft annealed tool-steel bar that is so aggravating to the lathe man when he is trying to finish a nice smooth thread.

W. T. H.

Limit Gages.

In Fig. 1 is shown a limit gage for testing the thickness of the curved bottom of the U-shaped copper piece *A*, which is used in a dynamometer. We started to use the ordinary sheet-metal micrometer with a round anvil, but it proved unsatisfactory, as it wore too fast and the operator frequently made a mistake in the reading. There are three sizes, Nos. 4, 5 and 6, of the U-shape piece made, and a limit of 0.002 inch is allowed. After the piece is blanked out and formed to shape, it is rolled in a machine to the required size; but after the machine has run a while and the rolls become warm, the distance between the rolls changes, making constant gaging necessary; so we came to the conclusion that a special gage had to be made.

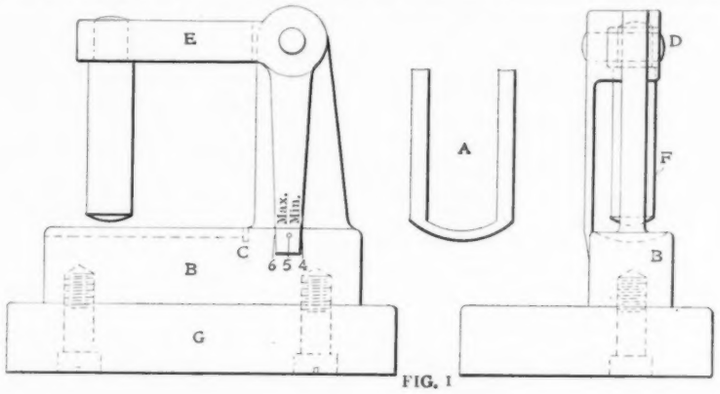


FIG. 1

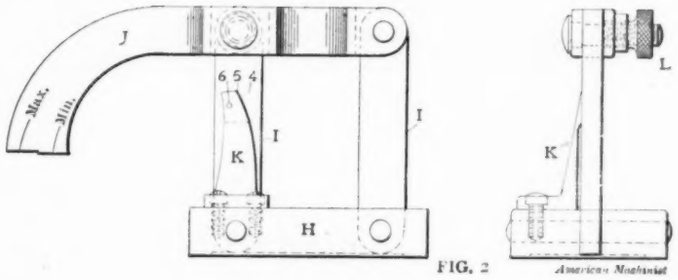


FIG. 2

LIMIT GAGES.

The body *B* of this gage is of machine steel and case-hardened. A 1-16 inch thick cutter was dropped in the corner *C*, and with a forming tool of the shape of the model the seat in *B* was formed, then scraped and, after hardening, lapped straight. At the top is a ¼-inch hole, and in this pin *D* is a working fit. The arm *E* is made of machine steel, and slotted to fit *B* nicely; the pin *D* being a driving fit in the hole through the arm. At the other end of arm *E* is a 5-16 inch hole, to receive the end of plug *F*, which is of tool steel with the large end hardened in water. The pin is a driving fit in the arm. At the side is extended a flat wing, whose graduations with those on the base show whether the piece being tested (No. 4, 5 or 6) is within the required limits of accuracy, as determined by the lines marked "Max." and "Min." The gage is held on a small gray-iron base-plate *G* with two screws.

Fig. 2 shows a height-gage, which was made for use in connection with the testing of the U-shape piece in Fig. 1; it has since come in very handy on many other small jobs, as it can be set to the model or to a certain height and still be absolutely parallel within its range. The U-piece had to be placed on the end of a long rod in a certain operation, and this gage was used to get both ends within the limit of 0.002 inch.

The base *H* is of machine steel, case-hardened, each end having a 3-16 inch slot to receive one of the arms *I*, and a hole through the side for a ¼-inch pin. The bottom is milled out 1-32 inch deep to within ¼ inch of the edge, and after being hardened is lapped to a true surface. Both arms *I* are of machine steel, and a ¼-inch hole is drilled in each end. The pins are working fits in these holes, but a driving fit in the base-block. The arm *J* is made of tool steel, with the gaging end only hardened. On this end the maximum and minimum steps are made and marked for the allowance of 0.002 inch; in the other end and at the middle 3-16 inch slots are formed for the uprights *I*. At the side is a finger *K*, which is held in posi-

tion with two screws. This registers the number of the piece to be gaged. The gage is clamped securely with a screw and nut *L*. The screw has a shoulder which bottoms on the forward arm *I*, and the nut is counterbored to receive a spring for tension when the nut is released. E. W. N.

A Hollow-Milling Operation.

We use in our business a large number of malleable-iron corners, as shown in Fig. 1. Each has four ⅜ inch tits, *a*, to be milled down to 5-16 inch, which fit into holes punched into 1½x¼-inch flat iron, and four are riveted to form a square frame. To accomplish the milling of the tits I made a jig, shown in Fig. 2, which consists of a gray-iron frame 8 inches square, with sides 1 inch thick. The corner to be milled is placed in the jig sideways, openings being left at *b* to accommodate the tits. Upon depressing lever *c*, which is removable, the eccentric *d* in turn presses upward the piece *e* (which has an elongated hole), thereby forcing the corner up against the jig and clamping it there. The piece is then ready to be milled, which is done in the drill press

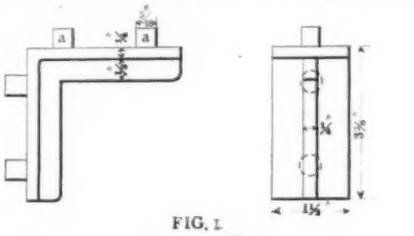
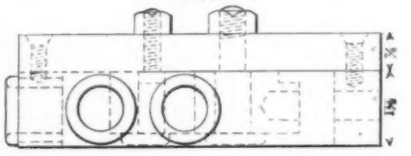


FIG. 1



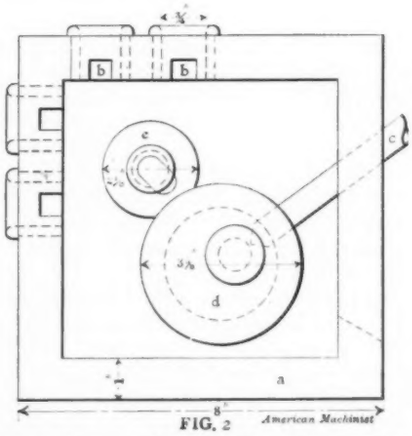


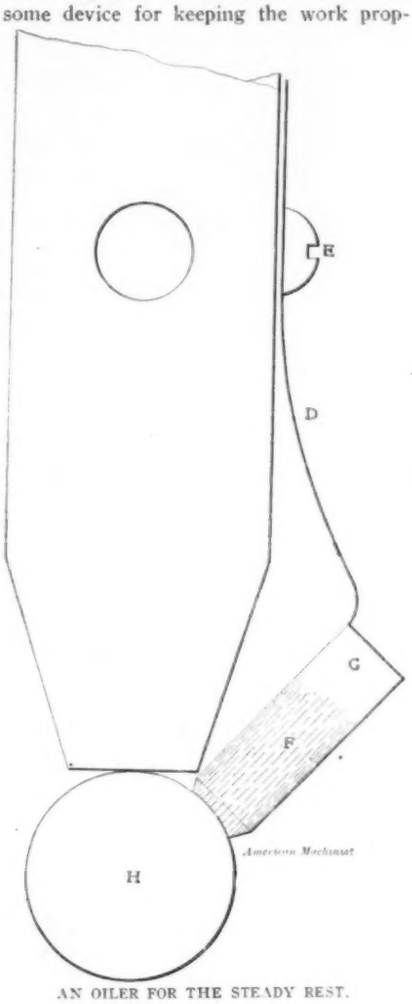
FIG. 2

FIXTURE FOR HOLDING THE WORK WHILE HOLLOW MILLING.

with a hollow mill, set to a stop. Eccentric *d* is adjusted to clamp the nut tight within ¼ inch of its highest point, to allow for variations in the material. The jig has given excellent satisfaction, taking into consideration the roughness of the piece to be worked. J. K.

A Self-Oiling Steady-Rest.

Having worked for some time in a shop where a great deal of work is turned in the steady-rest, I came to see the need of some device for keeping the work properly lubricated while turning, especially when heavy cuts had to be taken. Finding trouble in setting the jaws just tight enough to hold the work without vibration, at the same time not tight enough to heat the work, causing it to expand and finally rough up, I fell to experimenting with something that would keep the rest constantly well oiled. The following is the result of the experiments.



AN OILER FOR THE STEADY REST.

A piece of sheet metal—steel or brass preferably—about .025 inch thick, is bent at the end to form a rectangular tube. The tube is filled with a closely fitting piece of soft felt, *F*, such as is used to pack oil wells in bearings. This I made just long enough to pass through the tube and come in contact with the work *H*. The space *G* is just large enough to hold a squirt from the oil can when oiling the machine in the morning, or when beginning the job.

The curve *D* is caused by tightening the ¼-inch screw *E*, which gives just pressure enough to hold the felt in good contact with the work. The oil cup should be made as wide as the jaws of the rest with which it is to be used.

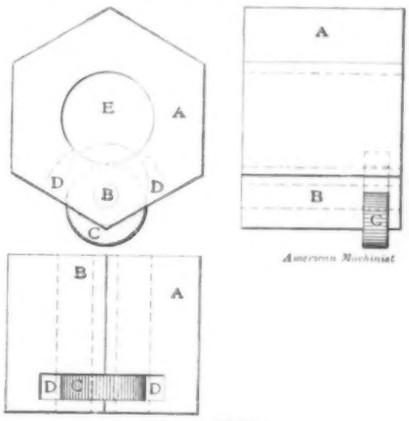
This oiler seldom has to be moved in changing from one size work to another, the spring compensating for the change. Being fastened to the jaw itself, it moves up and down with the jaw. When opening the rest it is not in the way and always comes back in place on closing it. I found this to give sufficient oil and not daub up the lower part of the rest with a large quantity of oil, as when oiling from the can in the ordinary way.

TOOLMAKER.

A Stud Puller.

The lot of the self-respecting inventor, born of poor but honest parents, is indeed an unhappy one. Two months ago I invented an absolutely new filing device, one of those every-day necessities which—like the Keeley motor—was bound to revolutionize modern methods. Before laying out fifteen dollars (which I didn't have) on an application for a patent, I spent my last five-spot on a search. And what do you think I found? A scamp, out in the backwoods of Idaho, had stolen my idea—stolen it and patented it, eleven years before I thought of it! So I was out five dollars for nothing. Ah, how truly spoke the seer who said, "Necessity is the mother of invention." He might even have gone further and said the sire, brother, sister and bosom-friend also.

The illustration shows a stud puller I devised and made about twenty years ago. The hexagonal part *A* is made of machine steel, slotted at *D* to receive the



A STUD PULLER.

nurled eccentric gripping roll *C*, which is pivoted on *B*. The roll *C* and pin *B* are tool steel, tempered, while A is case-hardened.

The operation of the stud puller is this: The device is slipped over the stud, with the roller *C* near the bottom. If the stud is being put in, the eccentric roller *C* is swung to the left till the teeth in it grip the blank portion of the stud; the wrench then screws the stud to bottom. If the stud is to be withdrawn, the roller *C* is swung to the right, and in this position it grips the stud so that the wrench will screw it out. DIXIE.

The Varied Entertainment of the Mechanical Engineers.

Each successive annual meeting in New York of the American Society of Mechanical Engineers, fifteen of which meetings it has been my privilege to attend, is always different in essential particulars from every one which preceded it, and this is as true of the meeting of December, 1905, as of any other. There has been not only a gradual but constant change in personnel and practice, but each meeting has also had its special features and incidents which have emphasized for it a certain individuality. In the earlier years the normal function of the society had full domination, and all the available time of the meeting was devoted to the reading and discussion of the papers presented. This was of course of high and permanent benefit, not only to the members present and participating, but to the engineering world through the subsequent publication of the transactions.

But a decided change has come in the scope of the proceedings, and it would seem to be now scarcely possible to have a satisfactory and successful meeting of the society if dependence were placed solely upon the reading and discussion of papers. I am not now saying or suggesting that the society or the community is a loser by the change. None of the time of the meeting goes to waste any more now than before, and the incidental fillers provided are each usually of interest to a greater number than are the specific and formal papers and their accompaniments. The filling of all the available time of the meeting is not left to chance or guesswork, but is throughout intelligently planned and arranged for, and someone deserves large thanks for the results secured. We must all believe that to Dr. Hutton, the honored secretary of the society, we are most of all indebted.

The interests of the society at the recent meeting were well looked after in the providing of the place for headquarters and for the stated sessions. The society has long outgrown its house for all the purposes of its annual gatherings, but it could not well have been more comfortably at home than in the rooms of the Edison Company, the meeting hall especially being suggestive of an ideal for a most important detail of the new Carnegie Building. If, among its other facilities and comforts, the new engineers' house has a hall as beautiful and in every way as satisfactory as that—except as to the stairways—there will be many who will have something to be proud of.

Now, there are at least four special events of the recent meeting to be remembered and to be spoken of with commendation—President Freeman's address, the session held on the "Amerika," the visit to the Worthington works and the lecture by Professor Wood. Taken collectively, these illustrate the wide reach and the all-embracing interest of the modern engineer.

The address of the retiring president of the society is of course, a fixture of the program. This address is usually upon an unannounced and unexpected topic which is by custom selected from the matters and experiences most intimately connected with the active life of the speaker. The society confidently expects him to talk about the things which he knows the most of, and so the president of three of the largest industrial fire insurance companies, and a most eminent national authority upon fire protection, presented a thoughtful and exhaustive paper upon the theater fire problem. This paper was of the highest interest and importance, and everyone present learned from it many things as to the usual succession of events in a theater fire, as to the conditions of safety, and especially about the things which are of little or no avail in the emergencies which occur.

The holding of a regular and most important session in the state cabin of the largest and completest steamship ever built, was an event altogether unique, the unaccustomed surroundings not at all interfering with the accomplishment of all the routine of the usual annual business meeting. The absolute freedom accorded to all aboard to wander where they would and to see everything they wished to, with the refreshments provided and the souvenirs so lavishly dispensed, constituted a monumental triumph of liberality on the part of the steamship company.

To properly take care of a crowd of 900 suddenly dumped from a train of 10 cars is a difficult proposition to a manufacturing establishment like the Worthington Hydraulic Works, not accustomed to that line of business, especially when about half that number has been expected. First there was the taking of the photograph, which I am afraid could not have been much of a success, simply on account of the members overcrowding all the standing room. Then came the feeding of a hungry crowd. A splendid luncheon was provided, apparently in ample quantity even for the large number, and the ladies were comfortably seated and served in most orderly fashion. As to the men, I was impressed more than ever with the importance of insisting upon one thing when any kind of a feed is provided for a crowd. Never place anything where the crowd can get at it. Provide for handing everything out, and, as far as possible, have a sufficient number of portions dished up in advance. A caterer who does not insist upon the conditions under which his luncheon is to be served, does not know the most important half of his business.

When the crowd was distributed through the works, the works proved much the bigger of the two. What I remember best of the Worthington plant was, first of all, as that was the first building entered, the unaccountable noisiness of the machine shop; not a noise of hammering or separately distinguishable sounds, but a general and all pervading noise. Then there were the girls and women employed in core-making and in actual molding. They looked comfortable and contented and doubtless were doing their work all right, but I don't think I will have any girls in my foundry. The sand conveying plant and the molding machines were an interesting feature. The works are large and the buildings good for a generation. There is apparently space for a considerable growth of business without enlargement, which for new works is doubtless as it should be.

But to me the event of the meeting, most often to be thought of in years to come, was the lecture of Professor Wood. This was ostensibly—and actually—an exhibition of most curious photographs, but to me it was, first of all, an exhibition of a man. Professor Wood seemed to me the fullest man, the readiest talker and the straightest teller of everything as it came along that I ever saw. He is professor of "Experimental Mechanics" at Johns-Hopkins, and he not only professes, but actually does things continually. He is a man who should have unlimited money for carrying out his ideas "and no questions asked." The photos he showed of things not visible to the unaided eye were most marvelous. The series of positions showing how a cat turns over and alights upon its feet when falling, were, of course, not new, as even I had seen them before, but without a realization of their revelation. The lecturer explained so well the way in which the act is done that I am confident I could do the trick as well as a cat if I had about half an hour every time to do it in and some other accompanying conditions arranged to suit me.

Then there was shown us the photo of a bullet in active flight. Think of looking edgewise at a pane of glass and clearly seeing a flying bullet half way through it, with the air wave driven in front of it clearly visible and also the air eddy in the rear, the edge of glass crumbling to dust close around the bullet in front and the crushing back of a shaving of the bullet behind the glass.

In a moving picture of the explosion of a charge of dynamite, the sound wave was photographed and made visible. There was the usual burst of smoke or gas and simultaneously there started a little ghostly light streak which moved across the view and disappeared. We were told what to look for before the picture was shown, and then we saw this sound wave distinctly enough. I wanted to ask the professor if he could not also have made visible the smell of the powder.

The fish-eye photographs were perhaps as curious as anything shown, and they upset my previously conceived ideas most

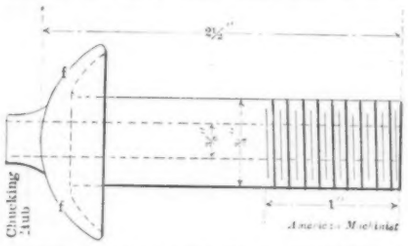
completely. We of course, who do not think, all have the idea that a fish looks out of the water straight at an object directly over it, or within the usual angle of atmospheric vision. The actual fact is that the eye of the fish, aided by the refraction of the water, has an angle of vision of 180 degrees above the surface of the water, and the fish, usually invisible to the fisherman above, can see everything all around down to the horizon or the water level. Most curious round photos were shown taken by a camera in an improvised miniature diving-bell sunk beneath the surface of the water. These showed, around the edges of the picture, the buildings and other objects surrounding the pond, with things more directly above the camera located toward the center. No wonder our fisherman's luck is no better.

The whistling lady interpolated into the entertainment at Sherry's should not be forgotten. The meeting as a whole was an undoubted success.

TECUMSEH SWIFT.

A Simple Method of Finishing a Brass Casting.

I had 100 brass pieces to finish, as in the sketch; the only tool I had was an ordi-



THE BRASS CASTING TO BE FINISHED.

nary screw-cutting engine lathe, and I did the job as follows:

First I drilled the hole, put the casting on a mandrel, then cut the thread and finished the piece in this way, as I could not figure out a better way to chuck it, owing to the finished end.

Not long after, I received an order for 500 more. I took the sample piece to a brass foundry, where they also did brass finishing. I asked for a price on 500 like sample, and to my surprise their price was less than half what I could do them for. I gave them the work, and this is how they did it:

The first thing they changed was the finish allowed on the pattern; this was turned down to the diameter of the thread. They then put a small hub on the pattern, 1-16 inch larger in diameter than the hole, to chuck the piece by. When the piece was chucked, ready for work, they put a drill in the tail spindle and drilled the hole; then cut the thread with a die, finished the spherical head and cut the hub off at the same time.

The hub did the work in a simple way; everything is simple if you know how.

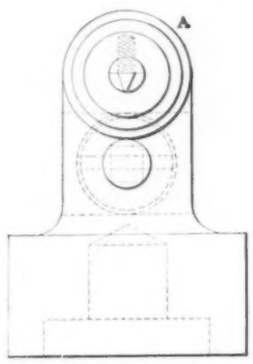
BRASS.

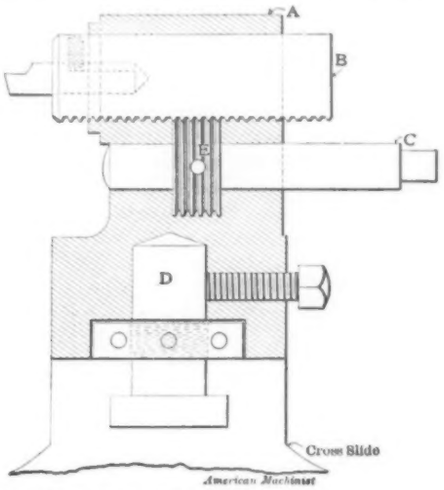
Two Special V-Blocks.

Fig. 1 shows a V-block, combined with a jig, for drilling holes through the center of a shaft where a slot has to be cut through with a slotting tool. The V-block carries a piece *A* that is bolted fast to it, and which has a screw at the top to hold the shaft in place. Piece *B* receives the bushings, of which there are several sizes, and has two oblong holes, so that it can be adjusted down to the nut by means of the two clamp nuts.

Fig. 2 shows a V-block used for milling keyways in shafts. The block is as long as the table of the milling machine, and has two clamps *C C* to hold the shafts in place. Several rings like *D* are made, of different bores to fit the different sizes of shafts, and each ring has the same size hub *E* to take the graduated disk *F*. The hub is secured at the end of the shaft by a key *G*. To the V-block is secured a pointer *H*, as shown. This arrangement is useful when keyways have to be milled at a certain angle, as shown at *K*. Any number of keyways can be milled, with accuracy and quickness.

J. M. MENEGUS.





TOOL FOR THE TURRET-LATHE CROSS-SLIDE.

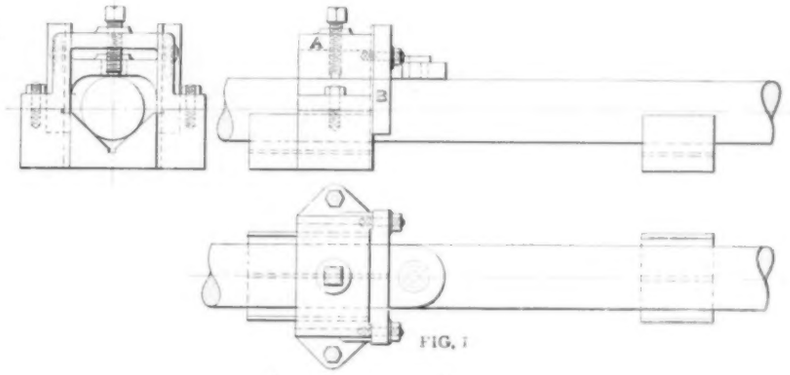


FIG. 1

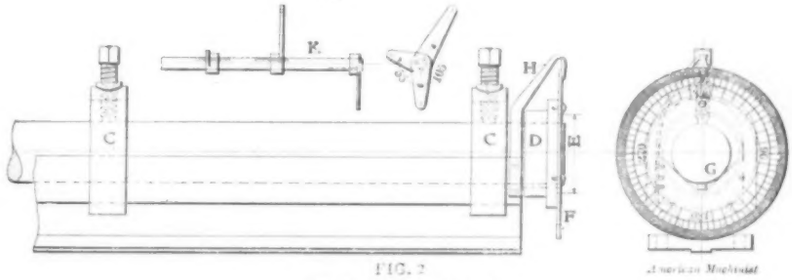


FIG. 2

TWO SPECIAL V-BLOCKS.

A Tool for the Turret-Lathe Cross-Slide.

When it is not convenient to mount a slide-rest in place of the cross-slide on a turret lathe, for facing, etc., the tool in the sketch is quite useful, as it may be used in place of the front tool-holder to put on the cut. It is well out of the way of the turret tools.

The body *A* is of gray iron. It is bored for the spindle *B* and also for *C*. The pin *D* is fastened in the T-slot by means of the nut, and body *A* is bored to clear the nut and fit the stem. The set-screw fastens the holder at any angle. The block is

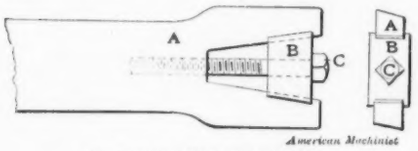
slotted through crosswise for the worm *E*, and the latter is made a nice fit in the slot.

If the spindle *B* is cut for the teeth with a hob of the same diameter as the worm *E*, and the centers are nicely located, no spline and key will be needed to prevent the spindle from turning round. The cutting tool is held by a headless screw.

B——, England. W. REYNOLDS.

An Expanding Flat Drill.

Twenty years ago, in Scotland, the flat drill was the standard tool for producing true holes in the lathe. When this tool is properly lagged with hard beech and in the hands of a skilled mechanic, it is an excellent one, the only drawback being that it is not adjustable. Some years ago, while going through a junk pile in a



AN EXPANDING FLAT DRILL.

second-hand machinery dealer's—a form of dissipation in which I delight—I came across the adjustable flat drill shown in the illustration. It is to be used for finishing only, and is a very satisfactory tool. The amount of adjustment varies, of course, with the shape of the tool; the one from the junk pile was for a 1½-inch hole, and allowed about ten thousandths adjustment. The screw *C* moves the wedge *B*, which sets the ends of the flat drill *A*.

SEA CLIFF.

Cutting Off Paper.

The other day, when cutting off paper, I thought how easily I tackled this job now, just with a tack and a string. I used to cut off blueprint paper with a knife or the scissors, and I was often annoyed because the knife tore off the corners and I didn't get the paper square. It also takes some time to take the big paper roll from the dusty corner, remove the cover, and with the scissors or the knife cut off a piece of paper, cover the roll again, and put it back in place. You are very likely to get all sizes of drawings, too. Now I spend half an hour every month in cutting off paper and then every time I want a standard-sized sheet I just pull out a flat drawer and take it. This is the way I have done it in the last year:

Pin a standard drawing on your table. Take a string about 6 inches longer than the drawing and fasten the one end with a big tack in the lower right-hand corner of the table; tie a key or something like it to the other end of the string. Let us say the drawing is 20 inches; then put the paper in line with the upper edge of the drawing and unroll the paper about 25 inches with the left hand; take the key with the right hand and lay the string just across the drawing. Fold the paper over the string and then with the right hand sharpen the edge from right to left, seize the key and tear off the paper with the string. If you want the blueprint paper rolled together again, let a boy help you, and you can easily cut sixty blueprints in a quarter of an hour, and you can cut square without wasting paper or tearing corners.

The tracing and drawing paper come in rolls double the length of a standard drawing, therefore I first cut the roll in two on a band-saw or with a hack-saw.

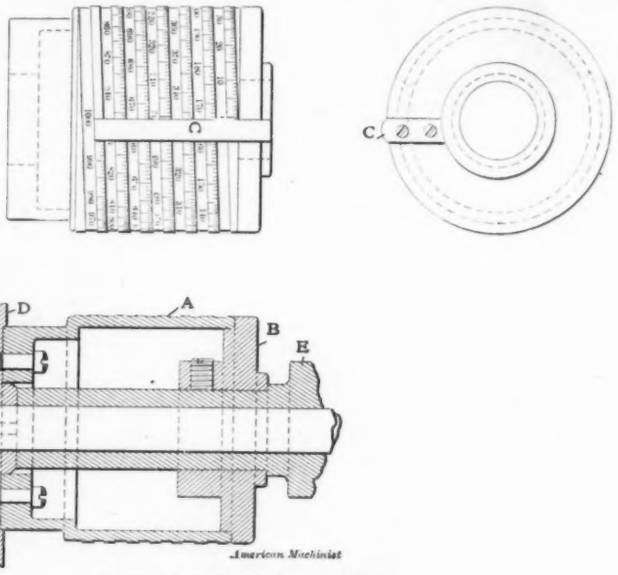
Holeby, Denmark. A. M. P.

A Helical Micrometer Head.

The helical micrometer attachment for a six-thread feed-screw shown in the illustration owes its existence to an error made by a firm engaged in the manufacture of turret lathes. The powers that be in the shops of the W. M. Company decided, after some discussion, to change their method of manufacturing by doing much of the work on turret machines, which up to that time had been done in ordinary engine lathes. Subsequently an order was placed with a New England firm to build a dozen large turret lathes according to specifications requiring heavy compound slides for the turrets, suitable for boring, turning and facing pieces up to 16 inches in diameter, and with feed screws of five-pitch to which it was intended to attach micrometer disks to suit the various kinds of work, because ordinary stops would not be suitable for working the odd-shaped pieces or for the accuracy required in the output. The roughing machines were to have graduations in hundredths and fiftieths, and the machines for finishing in thousandths of an inch. The object of the lesser graduations was not to dazzle the eyes of the roughing grade of help with too many lines on the disks.

When the first shipment of the machines arrived it was found on examination that the pitch of thread on the feed screws was six to the inch, the makers having overlooked the item in the specifications calling for a thread of five-pitch on the feed-screws, and put in screws with six threads to the inch, as was their custom in their regular commercial line of machines.

When the error was discovered there was consternation among the bosses because they thought that no device could be made to record movements of .001 inch with a six-thread screw without leaving a fraction thereof in doubt, and to send the machines back to the makers and have them refitted would entail a loss of much valuable time. Inside of a day I had thought up a scheme to overcome the trouble. Knowing that by using the circle of 25 holes on the index-plate of the milling machine and by indexing one hole at a time, the circumference of a piece between the centers could be divided into 1,000 divisions, it occurred to me that by indexing every sixth hole in the plate those 1,000 divisions would be distributed over six revolutions of the piece if it were cut with a helical path the same as a thread, and to suit the idea I made a drawing of the device, which was then made and attached as shown.



A HELICAL MICROMETER BARREL.

Part *A* is made of machinery steel, and a groove is cut in its periphery with a pitch of four turns to the inch, ⅛ inch wide and .01 inch deep, for clearance for the graduating tool, and for receiving the numbers denoting the spaces of .001 inch along its course, and leaving a raised path on which the graduations are cut. For the greater part of its length it is bored to leave a shell of about ⅛ inch in thickness to reduce its weight and to fit over a

shoulder on part *B*, and on one end is a smaller bore to which is fitted a shoulder turned on the central ball of the crank-handle *D*. Through the same end two holes are drilled to receive the screws for holding the part to the handle, which has been faced on its inner side to insure a true hold. The purpose of the somewhat long blank part is to give an unobstructed view of the graduations behind the balance ball on the handle.

Part *B* is a supporting collar for the outer end of part *A* and for the part *C*. It is made of machinery steel with a shoulder to fit into part *A* and bored to fit over the screw sleeve *E* to which it is fastened with a screw. The angular part *C* is made of machinery steel, and that part of it extending over part *A* is rounded along its upper side for obvious reasons, the rounding terminating in two straight-edges. It is fastened to part *B* with two small screws.

With the same method as described in the foregoing, micrometer barrels reading to .001 inch can be made for any pitch of thread, whether it be 7, 9, 11, 11½, 13, etc., by indexing a number of holes on the 25 circle on the index-plate corresponding with the pitch of thread, provided of course that the number of teeth on the worm-wheel of the milling machine is 40. When indexing for a 7-thread screw the number of holes would be 7, for a 9-thread screw 9 holes, and so on. Thus the graduations on a micrometer barrel for a 7-thread screw would cover 7 turns of the helical path, and those for a 13-thread screw would cover a path of 13 turns.

The operators of the machines consider these helical micrometer barrels to be better adapted for the class of work done on the machines than the ordinary disks, because they can keep tally easier with the consecutive numbers for the successive tools during the operations on the piece of work.

H. E. R. MANBRAND.

A Profiling Job on the Vertical Miller.

Reading Mr. Grant's article at page 647, reminded me of a somewhat similar job

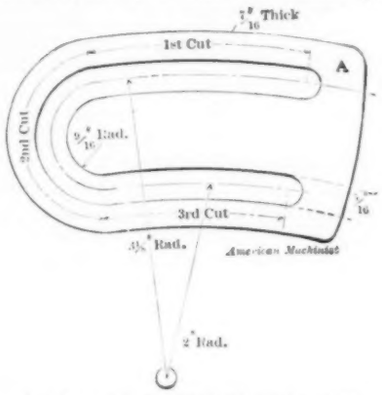


FIG. 1. THE CASTING TO BE MILLED.

which I undertook some time ago. Having to mill out the U-shape curved groove or slot which was cored in the gray-iron casting, Fig. 1, and not having a profiler in the shop, we decided to do the job on a vertical milling machine with the aid of the attachment shown in Fig. 2, the work here being shown by dotted lines at *A*.

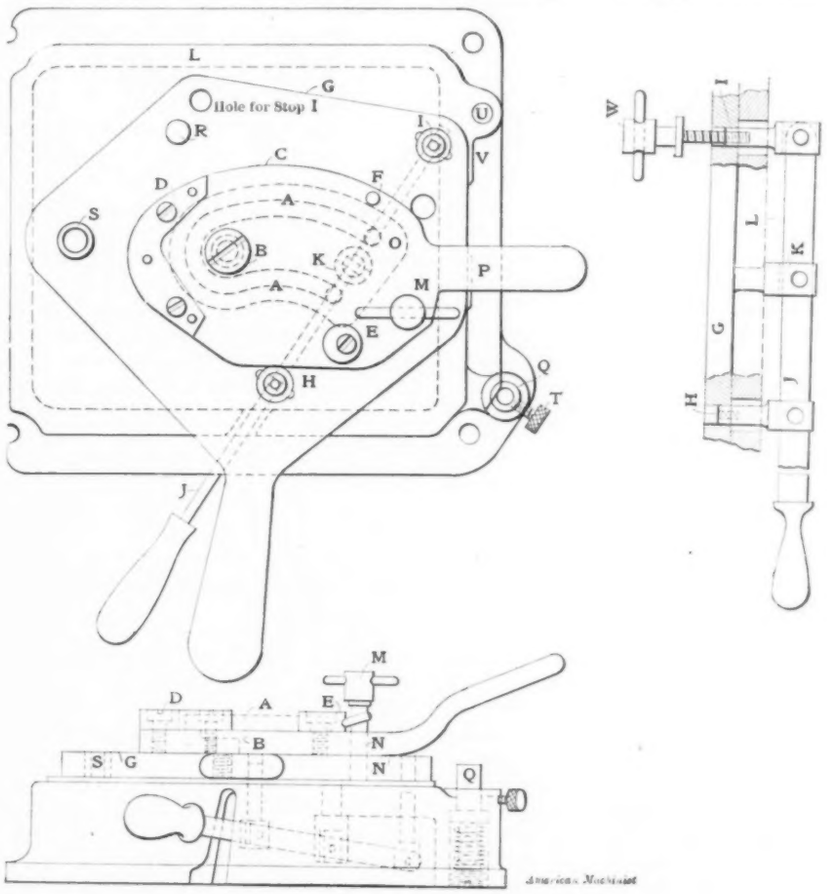


FIG. 2. THE PROFILING ATTACHMENT.

In this fixture, on a hardened and ground center-post *B* is a machine-steel plate *C*, and screwed and dowelled thereto a tool-steel locating block *D*. Conveniently placed are the tool-steel tightening cam *E* and the stop-pin *F*. Plate *C* is fastened by means of *B* to a machine-steel plate *G*, the latter being free to rotate on either of the pins *H* or *I*. The machine-steel lever *J* works on a fulcrum pin *K*, which is riveted into base casting *L*. Lever *J* controls the movement of pins *H* and *I*.

The method of operation is briefly as follows: The casting *A* to be machined is located on *C* and tightened against *D* and *F* by cam *E*. The plug *M* being then inserted into bush *N* and the corresponding bush *N*¹, lever *J* is raised, bringing into operation pin *H*. Into a hole previously bored in casting *A* at point *O* the cutter is then dropped, and plate *G* being swung about pin *H*, the first cut is taken until surface *P* and stop *Q* come into contact.

Next, lever *J* is depressed half-way, this leaving both stops in action, as in the sectional view, and so preventing any movement of plate *G*. Next, plug *M* is removed, and the cutter still being in the work, the small semicircular cut is taken by rotating plate *C* on center-pin *B*. The stop-pin *R* prevents over-running on this cut. Plug *M* is then replaced in *N* and through bushing *S*, which leaves casting *A* in position for the final cut. Lever *J* is now fully depressed, bringing pivot *I* into action and releasing *H*. After removing stop *Q* from the path of plate *G*, by depressing it against a spring and retaining it by means of nurled nut *T*, the finishing cut is taken by rotating plate *G* about center *I* until surface *V* contacts with stop *U*. The flanged plug *W* is screwed downward into either stop *H* or *I*, and serves as a steady while plate *G* is in operation.

C. F. H.

How Jones Kept His Scrap Clean.

"Gentlemen:

The last consignment of bronze and brass turnings received from you are about one-half aluminum; so bad that they are almost worthless. Unless you can make a reduction of at least 50 per cent. from the bill, we will ship them back to you at our expense, rather than accept them at the price quoted. Please advise us.

Yours very truly,

"THE COPPER & BRASS SMELTING CO."

Attached to this letter was the following:

"Mr. Jones:

Please note the communication from the Copper & Brass Co. This is a serious

matter, as the loss will be several hundred dollars. Please explain.

"GEN. MANAGER."

When Jones came back from dinner he found the above communication on his desk. He said a few words under his breath, and then sent the errand boy to find Sam, the sweeper, and tell him that he wanted him right away quick, or other words that meant the same thing. As Sam came into sight his first thought was to give him a good setting up, as he had done dozens of times before; then he said to himself, "What is the use? Sam is a good man—the best I ever had—and he is doing the best he knows how, to keep the chips from being mixed." So instead of opening on him as he intended to, he said to Sam:

"How many brass and bronze chips do you take up in a day?"

"Oh, about 300 pounds a day, sor."

"And how much of that goes into the sweepings?"

"About one-half, sor."

"Now, Sam, what is the reason that you cannot keep it any cleaner? Look at that call-down that I have just received from the office, and all from your letting the chips get mixed."

"Well, sor," said Sam, as he shifted from one foot to the other, "it is like this: The boys do not tell me when they shift over from bronze to aluminum, and the chips always get mixed before I can get 'round to take them out, and divil a bit do they care what I say to them."

"Sam, what are you getting now?"

"Nine dollars a week, sor, and with me overtime and Sundays it comes up to nearly eleven dollars."

"Well, commencing with to-morrow we will make a different arrangement. I will give you fifty cents per hundred pounds for all clean chips, either bronze, brass or aluminum that you put into the bins, and five cents per hundred pounds for all the sweepings. You may put as much time in the work as you please, and can put any spare time you have on the other work at the same rate per hour that you now get."

Sam scratched his head and said, "And if the chips get mixed up it's up to me, sor?"

"Yes, that's just it; and if you keep them clean you will have a good week's pay, but if you do not, the old woman will be after you. Start in to-morrow morning, and let me know in a week how many sweepings you have."

Sam sidled off looking very dubious about the five cents per hundred pounds for sweepings, but willing to give it a trial. At the end of a week he came around to the desk.

"Well, Sam, how many chips have you?"

"Seventeen hundred pounds, sor."

"And how many sweepings?"

"Hundred and ten pound."

"Why, how's that? Didn't there use to be one-half clean chips and one-half sweepings?"

"Well, sor, it was the aluminum that always played the dickens with the brass, and that made the trouble, and I told the boys that if they didn't tell me when they changed over from one to the other I wouldn't have anything in me pay envelope Saturday night, and they have been pretty good about it, and when there was a pound that got mixed up I will tell you what I did, sor. I got three coal sieves out of the storeroom—a coarse and a fine one and one in between— and then I laid a big sheet of paper on the floor and run the mixed chips through the coarse, then the next and next, and I cleans out most of them. The aluminum chips are more like shavings and they do not get through the sieves so easy."

"And what have you got coming to you this week, Sam?"

"About $12.50, counting the time-work and the overtime on the boiler, Sunday."

"All right," said Jones, "we will keep on that way until further notice."

Jones thinks he has found a way to solve the evil. The percentage of mixed chips is reduced down to one-tenth. Sam is happy and he is not getting any more "billet-doux" from the office. Boiled down, the facts of the case are these: Put the collecting of the chips on a piece-work basis, where it appeals to the man's pocket when he sees the aluminum and brass getting mixed, and when the men know it is for the pecuniary interest of their fellow-workman they will take a little pains to see he is given a chance to keep them clean. It is an evil that every foreman who handles a good deal of brass, bronze and aluminum work has to contend with, and perhaps Jones' experience will be of benefit to them, also. A. P. PRESS.

Marking Blind Holes—Setting Lead-Screws and Feed-Rods.

Often we have occasion to drill a hole to match another hole previously drilled, but so situated that we cannot scribe through it. The following trick is well known to tool builders, but I have never seen it used outside such shops. Suppose the hole at *A*, Fig. 1, has been drilled and tapped, but that it does not run clear

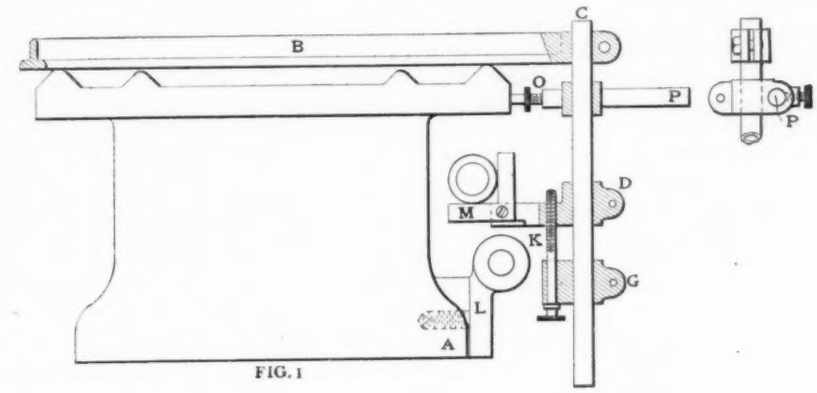


FIG. 1

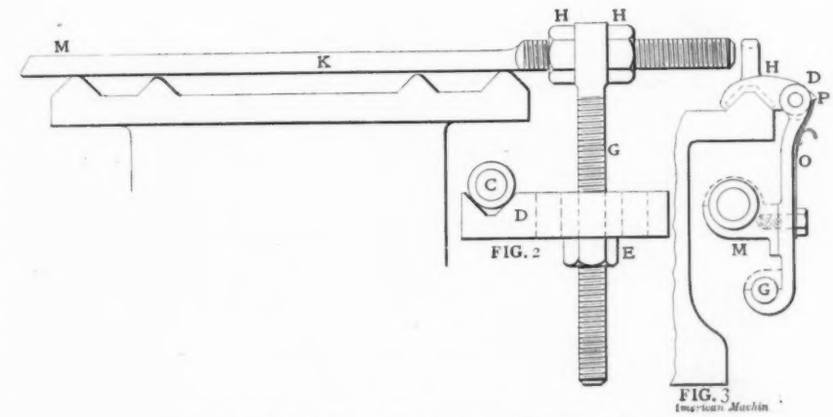


FIG. 2

FIG. 3

MARKING BLIND HOLES—SETTING LEAD-SCREWS AND FEED-RODS.

through. We will clearance drill it a thread or two—as we ought to do in any case—and then with an old lathe center upset the edge of the hole by driving it in smartly. Now we will set box *L* up against it just where it is to go, having previously chalked the face. Now hit it a clip with a sledge hammer, and we will find a clear and distinct circle marked to show us where to drill. To line up such boxes I have used the following device, which I have never seen exactly followed anywhere else, possibly because it is so simple.

Fig. 2 shows a partial end view of a lathe bed with the lead-screw *C* in place. *D* is a block of gray iron, cut out with a

"V," as shown, and drilled with two or three holes to fit snugly over the vertical screw *G* and so as to be adjusted for height by the nut *E*. It can also be adjusted horizontally by the nuts *H H* on the threaded end of the flat bar *K*, which in turn is clamped across the bed by a C-clamp at *M*. The nuts are all a free "finger fit" on the screws, so that all adjustments can be made without a wrench. At first we made the vertical screw with two nuts, one above and one below the block *D;* later we have made *G* a 1-inch screw, but reamed block *D* 15-16 inch and turned the screw to fit it. This gives sufficient bearing on the top of the thread, so that the block *D* will not jam the threads. A small investment will make up a few of these hangers and will pay well, as by setting the lead screw that is to be used we can fit the boxes at both ends at once, and also if there are rod and screw supports we can fit them at the same time; so in setting up a long lathe we can keep quite a gang at work on it at once.

To set the rod and screw in line we have the device shown in Fig. 1. Bar *B* is laid across the V's, and carries a vertical rod—or better, a tube—*C* made to slide up and down and to carry the heads *D* and *G*, which can also be clamped wherever desired, and which act on the same plan as the heads of the Billings & Spencer surface gage; that is, we clamp the head *G* tight near where we want it, and then adjust *D* by means of the screw *K* up and down till the brass angle-piece *M* just touches the under side of the lead screw. For horizontal adjustment the screw *O* in the end of rod *P* is used. *P* can be slid in and out as shown for the coarse adjustment, and the screw used only for the fine adjustment. Two or three different angle-pieces at *M* will allow of covering a large range of sizes. In using this rig, care must be taken to set it squarely across the bed of the lathe.

Speaking of rod and screw supports, how is the one in Fig. 3 for simplicity and effectiveness? To fit this up we drill holes *D* and *G* without regard to their exact distance apart, but in the center of the ends of the castings (the castings are made according to the dotted lines). Then we rivet a cold-rolled pin through at *D*, cut off the dotted part over *G*, clamp it up to the feed rod and clamp it down to the "V" at the top and babbitt the top in place. Then we fit up the box *M* to carry the lead screw, cut off the top, which is only there to give us a complete hole to bore, and bolt it on as shown. Then we put on spring *O*, which fits under catch *P* on the cap to keep the whole thing from falling off, and, with the addition of a dowel-pin to keep the screw bearing from turning and a hook on the spring to pull it out by, it is done at about as little expense as possible. And it is so easy to change it from one side of the carriage to the other that the workman likes to play with it, and so keeps looking after it.

E. H. FISH.

Worcester, Mass.

The Capitalization of Skill.

What you had to say at page 829, Vol. 28, Part 2, on the "Capitalization of Skill" struck me at first sight as being just so, but as I thought it over it occurred to me that there might be something in it from another point of view. Suppose, for instance, that at some future date, say seven years ahead, if I am alive and well and able to work, I have good reason to believe that I will receive $1,000. We will also suppose that I have a seven years' term policy in a good life insurance company, which costs me about $100 to carry for the seven years. We will also suppose that I have a health and accident policy which covers me equally well at a cost of say another hundred. Then, too, this $1,000 is only about as good as about $700 deposited in a savings bank, or put out on a good real estate mortgage to-day. So that $1,000 would be a good risk to-day at $500. If I could be sure of $1,000 every year from the time I was 25 till I became 50, 25 years, the first instalments would be worth a larger per cent. of their face value and the later instalments more, but they would likely average to be worth $300 to $350 each. Total, $7,500 to $8,750 which invested at 11 to 13 per cent. would give a thousand dollars income. So if I wanted to hedge the whole matter, I would take out 25 term policies and a lot of health policies and spend all my income the first few years paying for them, but with the assurance that my estate was good for what I expected to get.

Now I don't expect to see anyone try this scheme, for I think that we nearly all think as I do, that to put a money value on training or education is the wrong way to look at it. Every step higher that a man takes in his income means added expense which he must stand if he is to hold his head up with his new associates, and he doesn't have any more left at the end of the year, that does him any good, than before, and in the greater number of instances that I have seen intimately, the more money one makes the less happy he is. Don't think from this that I think education wrong, but rather judge that the reward for the effort of getting an education is internal rather than external, and that we really gain more from the satisfaction which our training gives us than from the money side. If we could only get over the idea that what our neighbors think about us is of prime importance rather than what we think ourselves, we might get a few more pennies laid aside for a rainy day with less nervous wear. Of all the inefficient things that I have seen, the most inefficient is our social system, just because everything is done to make a "front," with the result that our social architecture is like that of the house which was "Queen Anne in front and Mary Ann behind." But then, perhaps, we will yet come to see that they do not do all these things so badly in the other hemisphere and settle down to the idea that health and peace of mind are worth as much as show.

But to get back to the subject, learning, whether mental or physical, is one of the few things of which we can give and have more left than we began with. It comes the nearest to eating our cake and having it of anything yet known. But the person who spends his time teaching, ought not to be paid for the teaching, since that costs him nothing, but instead should be paid for the time lost from other and useful work which he might and could do. This system would work rather a revolution in our teaching forces, but I see no reason why a person unfitted by training or naturally incapable of earning an honest day's wage should be supported in comparative idleness by the community, setting our youth an example which tends to anything but industry. If some of our technical schools should make their professors prove their worth by getting out in the cold world every few years, we would likely see a readjustment of their staffs which would lessen the gulf between technical and practical men.

"ENTROPY."

It seems to me that in your editorial at page 829, Vol. 28, Part 2, on "The Capitalization of Skill" you have cut the subject short and ignored at least two important points. As you state the case, with $10,000 in the bank, you are right enough, but is there one chance in ten that the ten-thousand will get into the bank or remain there if it does? assuming, as it is only fair to do, that the same boy who gets the money is the one who gives up the skill. And again, are not the chances about as ten to one that the young man can get the trade or education when he cannot get the ten-thousand dollars? You ought not to overlook the fact that the boy can lose the money and he cannot lose his trade or education.

JOHN E. SWEET.

Syracuse, N. Y.

[We had no idea that we had exhausted the subject, but intended only to present a few considerations on the other side. Our remarks were, of course, based upon the supposition that the $10,000 was in the bank or otherwise invested. If the value of a trade or technical education is to be compared with $10,000 yet to get and that may never be gotten, then we vote for the education, of course. The boy can lose his trade or at least he can lose the opportunity to make use of it. which is the same thing. Accidents and loss of health due to confinement indoors are doing this every day, and we have in

late years seen the trade of wood engraving almost entirely wiped out of existence. Of course we would be the last to deny the value of a trade, but we think some of the capitalized valuations placed upon trades are erroneous.—ED.]

Rock Drills Operating on the Pneumatic-Hammer Principle.

One of the questions which is the cause of considerable discussion at present, and which will undoubtedly arouse even more interest in the future, is whether rock drills operating on the pneumatic-hammer principle, *i. e.*, delivering the blow to the upper end of the drill-bit, will drill as rapidly and to as great a depth as the older style drills, in which the drill steel is reciprocated instead of being struck on the end. Drills operating on the latter principle are by far the more common, but the former type of drill is rapidly coming into favor; hence the controversy.

Perhaps the readers of the AMERICAN MACHINIST will remember an article which appeared at page 673, Vol. 28, Part 1, entitled, "The Hammer and the Blow." In this article it was maintained that drills operating on the pneumatic-hammer principle were only good for drilling short holes, and lost all their efficiency when certain depths were reached. The writer, however, very wisely refrained from stating the exact depth at which these drills become inoperative, and left the question to the imagination of the reader. It can be stated here, however, that recent tests have shown conclusively that these drills will operate just as effectively as any other type of drill in holes of over 20 feet in depth.

Before going into this question, however, it should be said that there are two rock drills of the pneumatic type now on the market. One is operated by compressed air and the other by electricity; in both, however, the drill steel is struck very rapidly by a reciprocating hammer, at the same time being rotated slowly and continuously.

The analogy to the pneumatic hammer is more marked in the case of the compressed-air drill than with the electric drill, however; since, in the latter, the hammer is moved by the action of an enveloping reciprocating cylinder. The hammer is therefore drawn backward, due to the formation of a partial vacuum between it and the rear cylinder head; upon the return stroke the rapid downward movement of the enveloping cylinder hurls the hammer against the end of the drill steel with great force; the hammer in this case weighing 10 pounds, acting through a stroke of 4 inches and striking 600 blows per minute.

We now come to the reasons for constructing rock drills on the pneumatic-hammer principle. In the first place, it should be remembered that in this type alone is water successfully forced to the bottom of the hole. This is a very important advantage, as it permits of washing away the crushed rock and allows a stream of cold water to play continuously on the cutting edges of the drill-bit, thus preserving its temper and increasing its life. In the case of the reciprocating type of rock drill there are no means of continually forcing water to the bottom of the hole; the drill-bit has, therefore, to be moved up and down through a heavy formation of mud, thus greatly retarding its speed and acting as a cushion for the blow, since all this mud has to be expelled from between the drill-bit and the bottom of the hole before the cutting edges can come in contact with the rock. Furthermore, the constant rubbing of the drill-bit against the side of the hole wears away the gage of the cutting edges very rapidly. With the percussion drill, on the contrary, the drill-bit always remains at the bottom of the hole, except for a slight rebound, and the gage is consequently preserved for a longer period; the holes are more perfect and a marked saving is effected in the cost of sharpening the drill steels. Furthermore, the constant reciprocation of the drill steel in a hole filled with mud means that a large amount of power is used up in overcoming friction and in lifting the heavy drill steel before each blow. As the hole becomes deeper, the weight to be lifted becomes greater and the friction is increased. This tends to retard the speed of the drill and, as a matter of fact, a drill operating in a hole 15 or 20 feet deep will seldom run more than two-thirds as fast as it would in a hole only 4 or 5 feet deep. This, in the writer's opinion, explains the fact that the pneumatic-hammer type of drill will operate just as effectively as the reciprocating type for deep holes. The bit is always resting on the bottom; the forcing of water, under considerable pressure, to the bottom of the hole, continually washes away the crushed rock which might tend to cushion the blow. Furthermore, there is no slowing up in the action of the drill when depths of 15 or 20 feet are reached. This probably equalizes the loss due to part of the energy of the blow being dissipated in the form of heat or used up in compressing the end of the drill steel. It must also be remembered that this type of drill strikes at least a third more blows per minute than the reciprocating type and that this lead increases with the depth of the hole.

Another factor operating in favor of the new type of drill is its ability to drill a straight hole and not be deflected from its course by seams or pockets. Deflection of the drill-bit causes it to stick or "fitcher," as the miners say, and leads to endless delay and trouble. It is particularly noticeable in drilling through seams running in a line diagonal to the axis of the drill hole. When the new type of drill encounters such a condition, the drill-bit action is such that the cutting edges rebound but a small distance from the bottom of the hole and, being supported by a water tube to within about three inches of the cutting edges, any sticking or "fitchering" is prevented; even under the worst conditions but a slight deflection is produced. It is even possible to drill one hole at a very slight angle across another, giving but a slight deflection in the second hole.

And now a word in regard to the power required. It must be apparent to everyone who reads this article that the new type of drill can use but a small fraction of the power required to operate the reciprocating type. Furthermore, the amount of power always remains the same irrespective of the depth of the hole, since there are no heavy drill steels to be lifted at each stroke and no friction to overcome except the friction in the drill itself. This permits of a reduction in the number of models which have to be manufactured, and which the user has to buy in order to have the proper sized drills for different classes of work. The size of the drill is governed by the diameter of the hole, and is not affected by its depth. The manufacturers of the electric drill put out only two sizes, one for drilling small holes for plug and feather work, and the other to correspond with an air drill with a 3-inch piston.

It will be seen therefore that the new type of drill possesses advantages which the reciprocating type can never possess, owing to radical differences in design and breadth of application.

W. R. HULBERT, M. E.,

[The above statement is interesting and we believe true, but there is nothing in it which in the least controverts the statements of fact made in the editorial article referred to. The experience recorded in that article was an actual experience, and we simply called attention to the fact that in these matters the weight of the hammer and the character of the blow must be adapted to the length and weight of the drill used. Our illustration of the ounce hammer delivering blows upon the upper end of a crowbar ought to have made our meaning plain, *i. e.*, that if a crowbar or a rock drill is to be driven into any hard substance, a sledge hammer or a heavy maul must be used. With any drill acting upon the principle advocated by Mr. Hulbert there will be some depth at which the mass of the drill itself will be such that no more drilling can be accomplished. It is the business of the designer to see that things are so proportioned that this limit is not reached before the required depth is attained. We had no idea, nor was our article intended to convey the idea, that such proportioning is impossible.—ED.]

Prepayment of Foreign Postage.

Referring to page 614 (Vol. 28, Part 2) and to the subject of "Penny International Letter Postage," yours is not the only office in which "the youthful personage who attaches stamps late in the day cannot be induced to take pains to distinguish between domestic and foreign letters." Ours used to be the same way, but now it is different.

Quite a while ago I noticed, as an interesting bit of experimental psychology, that whenever foreign mail arrived in the usual baronial envelopes as used abroad, it was an irresistible impulse to pick out the foreign letters and open them first. They were distinctive in size and could not be mistaken.

Applying the same pyschology to the "youthful personage," we now make it a practice in our office to mail all of our foreign letters in baronial envelopes, to distinguish them from the ordinary oblong envelopes used in domestic mail. The result is that our "youthful personage" never has any difficulty in picking out the foreign envelopes and weighing and stamping them by the half ounce, instead of by the ounce.

Mail for Cuba, Porto Rico, Mexico, Canada, Phillippine Islands, Hawaii and Guam of course carries domestic rates, and is mailed in the ordinary envelopes.

The stenographers address the envelopes when the letters are written, and it is far less difficult for them to use the square envelope than it used to be to have our "youthful personage" pick out the foreign mail after it was inclosed in oblong envelopes.

So far as letters go, we have eliminated the difficulty on underpaid postage, and others adopting this simple expedient can do likewise. E. F. DuBrul.

Of Miller, DuBrul & Peters Mfg. Co., Cincinnati, O.

Referring to paragraph at page 614, we would say that we, too, were troubled for a long time by letters to foreign addresses getting out of the office with only domestic postage attached.

Following a suggestion from an outside source that we use a special envelope for foreign letters, we have evolved a system which seems to answer every requirement. It is described in our "General Orders," issued to our office force under date of August 25, 1905, and we enclose a copy of same, together with one of our envelopes.

Merritt & Co.,
Jas. S. Merritt, President.

Philadelphia.

The General Orders referred to read as follows:

There have been numerous complaints, from time to time, from foreign correspondents about short postage on our letters. For example, a letter to England weighing one ounce recently went out of this office bearing a 2-cent instead of a 10-cent stamp. In consequence, the recipient had to pay the equivalent of 16 cents, double the shortage. An incident like this does not influence a prosp ctive customer in our favor.

To prevent such mistakes we now have special envelopes, Form 90, for use in foreign correspondence and that only. They are light-green in color, nearly square, and will take our large letter sheets folded in half each way.

When a stenographer writes a letter to any foreign country (*except* Canada, Cuba or Mexico, to which the rate for letters is 2 cents per ounce, as in the United States), she will address one of these envelopes instead of our ordinary white envelope.

When the letters are sealed and ready for stamping, the foreign envelopes will be obvious by reason of their special color and shape, and the mailing clerk will weigh each of them and affix stamps at the rate of 5 cents per half ounce or less.

If a stenographer finds it impossible, on account of enclosures, to use Form 90 for a foreign letter, she must as soon as she has written the letter, weigh the letter sheets, long envelope and all enclosures, and affix the necessary stamps, before presenting the letter for signature.

No letter to a foreign address is to be signed unless the instructions contained in paragraphs 3 and 5 of the foregoing have been fully complied with.

[The envelope enclosed by Messrs. Merritt & Co. has in the upper right-hand corner, in a square that will be covered by the stamp, the legend: "Foreign, 5 cents per ½ ounce."—Ed.]

Your editorial, regarding postage short on foreign mail, suggested to us that it might be to your advantage to call your attention to the method used in our office here, to obviate this trouble.

We have two envelopes, one foreign and the other domestic; samples of each are enclosed herewith. Whoever stamps our mail can hardly put a two-cent stamp on the foreign envelope without being grossly careless [there is a striking difference in color]; the stenographer who writes the letter addresses the envelope and knows which one to use. The foreign envelope, you will notice, is also of a different shape, conforming to the foreign idea of stationary.

The S. Obermayer Co.,
By S. T. Johnston.

Cincinnati, O.

The worst way, because ineffectual, and for other reasons, is to "jaw" the people who do the mailing. Our correspondents describe methods which have been evolved by thinking and which have proven in practice to work well. We hope all those who have had trouble will use them.—Ed.

Corner-Stone of the Engineers' Club Laid.

The corner-stone of the new building of the Engineers' Club, on West Fortieth street, New York city, opposite Bryant Park and the new public library, was laid December 23, at 2.30 P. M. by Mrs. Andrew Carnegie, whose husband declared the task well and truly done. The ceremony was quite informal, but the club was well represented by its officers and committees, including President W. H. Fletcher and Past-President John C. Kafer. The architects, Messrs. Whitfield & King, were also present. Fortunately the weather cleared during the afternoon, and thus the party were enabled to inspect the building, now up to the ninth story in the steel work and to the third in marble and brick casing. The records deposited in the stone included a Bible of 1905, a club book of 1905, copies of the *Herald*, *Tribune*, *Sun* and *Times* of December 23; a copy of the certificate of incorporation; a booklet of the old club house at 374 Fifth avenue; a half-dollar, quarter-dollar, dime, nickel and one cent; a card of W. L. Crow, the builder; a copy of Mr. Carnegie's letter of gift to the engineering societies and the Engineers' Club; a chronological history of the club; a list of members elected since the publication of the club book this year; a list of the incorporators of the club; the program of competition for the selection of architects for the two buildings, and floor plans of the new house.

Thawing Out Ore by Hot Air.

In the cold northwestern country during the winter months carloads of ore freeze up solid, so that the drop-bottom doors cannot be opened to dump the ore. In such cases it has been the practice to steam the ore, a method of thawing which is wasteful of heat, and also has the disadvantage of adding to the moisture in the ore, which subsequently absorbs heat for its evaporation. In a plant recently installed for the Zenith Furnace Company, at Duluth, Minn., the thawing is done by hot air, a frame building with heat-insulated walls having been constructed of a size to hold fifteen cars, and provided with apparatus made by the Buffalo Forge Company, which includes a large exhaust fan driven by a direct-connected steam engine, and a bank of ten heater coils, two of which are heated by the exhaust from the engine, and the remainder by live steam. The air, heated by passage through these coils, is discharged into ducts which lead it under the tracks and deliver it up against the car doors. The cost of thawing is reduced by this method, and some of the moisture is removed from the ore. The daily capacity of the plant is fifteen carloads, or about 450 tons of ore.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E.C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1905 *the* AMERICAN MACHINIST *printed and circulated* 1,059,100 *copies, an average of* 20,367 *per issue. Of this issue* 30,500 *copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.*

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The Decimalization of British Weights and Measures as a Substitute for the Metric System.

George Moores, secretary of the British Weights and Measures Association, whose visit to this country we have previously referred to, has returned home after conferring here with a number of people prominently identified (for or against) with the efforts that have been made to introduce the metric system here. Mr. Moores' attitude, and we infer, the attitude generally of those in and out of his association in Great Britain, who are opposing the introduction of the metric system there, is somewhat different from the attitude of our own opponents of that system. Mr. Moores, for instance, does not deny or attempt to minimize the objections that are brought against the present system; he acknowledges the full force of them. Most, if not all, that has been said here against the intricacy, the inconvenience and very large cost of using the present system of weights and measures is fully endorsed by Mr. Moores; only he, instead of favoring the adoption of the metric system as a means of getting over these difficulties, favors the adoption of what would be in most respects a new system, based upon the decimalization of the present British inch. For instance, he believes the thing to do is to take the present inch, and divide it into tenths, hundredths and thousandths, which latter division he would call a mil; while for larger measurements he would use a unit to be called the chain, which would be equal to one thousand inches. For measures of volume he would discard all the present units in use, and would take the volume of a cubic inch, calling that a "vol." A thousandth part of this he would call a "drop" and would use that as the smallest unit of volume, while a larger unit he would call a "gall" and this would be equal to one thousand cubic inches. Likewise in respect to units of weight he would discard those in present use, and for his fundamental standard would take the weight of a cubic inch of water. This he would call a "pon," and for the smaller unit would take a thousandth part of this to be called a "grain," while for the larger unit he would have one called the "wey," which would be equal to the weight of a thousand cubic inches of water. Thus the ratio between the unit of linear measurement, the unit of volume and the unit of weight would be the same as that between the various units of the metric system, and the other units would, similarly to that system, possess a ratio to each other which is decimal, and would possess all the advantages of a decimal system; Mr. Moores and his association not in the least denying but affirming the advantage of this.

Mr. Moores has made a special study of this subject, and hopes before long to visit all the colonies of Great Britain, and to confer there with the leaders of opinion upon this subject. He hopes in the end to form an organization, which shall be composed of committees in each participating country or political division, which committees are to be composed of representatives of the various sciences, arts, and industries; the chairmen of these committees to constitute a higher committee which is to confer with a general committee of control. This last committee will probably be located in London. Thus it is hoped to secure the consensus of opinion, and the best wisdom of the people most interested in a proper working out of the problem now before the people of Great Britain and America; two countries which Mr. Moores is especially anxious should co-operate in this matter.

We have tried during conversation with Mr. Moores to understand the philosophy of his proposition. It is, of course, plain that, so far as units of volume and of weight are concerned, it contemplates the eventual displacement of our present units by units that are entirely new—as much so as would be the units of the metric system. But when we come to the machine shop problem, the fact that the inch is already divided decimally—habitually so in machine construction—gives the new proposition a considerable advantage. Although if our sizes, based upon eighths, sixteenths, thirty-seconds, etc., are to be entirely discarded, and sizes based upon decimal divisions of the inch substituted therefor, then we fail to see why the arguments which have been brought against the metric system, based upon the alleged necessity for discarding the tools and fixtures based upon the present measurements, and the substitution for them of tools made to the metric system, do not apply with equal force to the plan proposed by Mr. Moores. Of course, the present tools may be used so long as their utility endures, and in the shop or elsewhere, when people choose to do so, they may continue to designate them by the present names, or, they may state their sizes in decimals of an inch when the occasion seems to demand it; but precisely the same thing can be done with tools made to the metric system, and in fact is done in metric-using countries. So far as we can see, the two systems are about even in that respect.

However, the system outlined has not been finally adopted, as the one which will be advocated by the association referred to. It is the one which Mr. Moores himself favors, but he wishes before advocating the definite adoption of any particular plan to secure a conference, such as we have mentioned. His candid recognition of the fact that there is a problem to be solved (which problem in England involves also the decimalization of British coinage), together with the fact that he has evidently made a serious effort to solve this problem without belittling it or

misrepresenting it, entitle his proposition to respect and consideration. We understand that ex-President Pritchett (of M. I. of T.), who advocates the metric system, has been much impressed by Mr. Moores' plan. It remains true, however, that its adoption would involve a considerable share of whatever of bother and expense would be involved in the adoption of the metric system, and the world would after all be, by its adoption, no nearer a universal system of weights and measures than it is now, if indeed as near. As to this we understand that Mr. Moores expects that some day the rest of the world would adopt and use the system adopted and used by the English-speaking peoples.

We have received the first number of a new publication called *Moody's Magazine*, which is edited by Byron W. Holt, and published by the Moody Corporation, 35 Nassau street, New York City, a company which makes a specialty of publications of a commercial and financial nature. The new magazine is intended for investors, bankers and men of affairs, and a notable feature of this first number is a symposium upon the effect of the largely increased production of gold upon prices, wages, stocks, etc. This and other articles in the magazine as well, will be of considerable interest to business men everywhere, and in all lines.

New Tools and Machine Shop Appliances.

HEAVY PATTERN TOOLROOM GRINDER.

The half-tone illustrates a modification of the regular No. 2 automatic toolroom grinder manufactured by the Walker Grinder Company, Worcester, Mass., and illustrated in these columns at page 170, Part I. The new machine embodies all the general features of the regular grinder, but it has a considerably wider and heavier bed, the distance between the centers of the cross-feed V's being 22 inches and the platen is also made considerably longer and heavier than in the regular machine. The headstock and footstock (which are like those used on the other grinder) are shown in the foreground, as is also the graduated blocking piece which enables the headstock to be set at any angle for common cutter grinding. The machine has hand longitudinal feed operated by a crank at either end of the platen and hand-screw feed by means of worm and worm gear shown at the right; it has automatic longitudinal feed in addition. The cross-feed is provided with a graduated hand-wheel. The head is equipped with vertically tilting spindle and universal adjustment, as previously illustrated; and the top of the platen swivels and is graduated for tapers in inches per foot. This particular style of machine is designed for handling large and heavy work, the cutter shown being 20 inches long by 8 inches in diameter and weighing over 200 pounds. The cutter is carried by supports which are bored out to fit the arbor, the top half of each support being cut away so that the work may be lifted in and out without trouble, and it will be noted that by supporting the heavy pieces by this method, instead of on centers, no undue strain is exerted on the platen. In holding lighter pieces the arbor may be held in V-shaped supports—for instance, in the two regular heads shown in the foreground, with the centers removed.

HEAVY PATTERN TOOL-ROOM GRINDER.

The tooth rest may be used either in a stationary position above or below the center of the work, or it may be fastened direct to the platen and moved with the work. In the case illustrated the rest is held on top of the grinding head, the radial side of the tooth being ground facing upward, so that as the wheel grinds across the cutting edge the heat is conveyed away from the edge and no appreciable bur is formed by the wheel. In following this method of grinding, however, it is necessary to hold the face of the tooth by hand up against the tooth-rest blade, the pressure of the wheel tending of course to move the tooth away from the blade. By turning the cutter end for end, the teeth being ground are made to face downward and in such case the tooth-rest is fastened on a bracket on the grinder head with the blade pointing upward, this being the usual and safest method of grinding, as the tooth is held down against the rest by the pressure of the wheel.

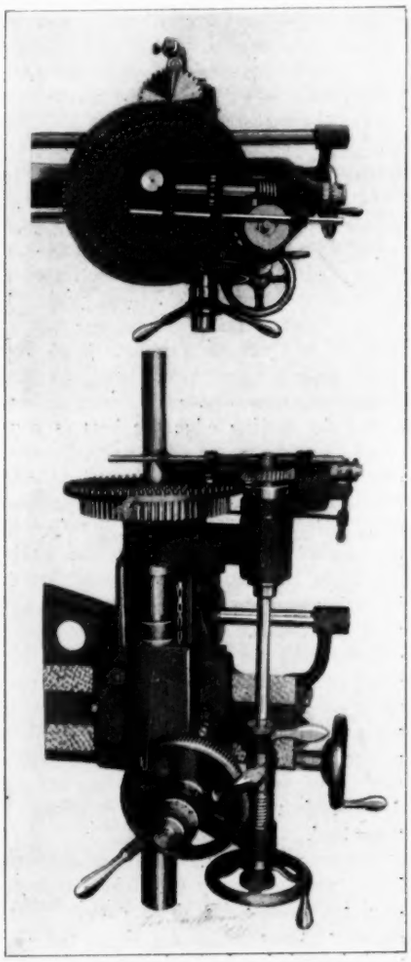
The machine also provides for grinding large face cutters up to 18 inches diameter, the holder for these cutters being shown to the right on the floor; the cutter is intended to be held on a short arbor turning easily in the bore of the holder. It has been found that while the side teeth of large cutters can be ground on a holder of smaller swing, by letting the cutter drop down back of the carriage, it is not satisfactory to grind such cutters in this manner, as it is usually necessary on face cutters to grind the periphery of the teeth and oftentimes to set the cutter at an angle and grind the corners of the teeth independently; in fact, the corners of the cutter become dulled much the quickest and there is much waste of material in attempting to sharpen the cutter entirely by grinding the side and periphery only. For this reason the cutter holder is given sufficient swing so that the cutter will pass over the top of the carriage at any angle, the grinding head having ample vertical adjustment to bring the wheel to the proper height to give clearance.

While the grinder shown is primarily a tool-sharpening machine, it is capable of

performing many other grinding operations, including cylindrical grinding on centers, internal grinding, and surface grinding, it being provided with power cross-feed when desired.

POWER FEED FOR DRILL SPINDLE.

This mechanism provides a positive feed for the drill spindle when high-speed drills and reamers are in use, and at the same



POWER FEED FOR DRILL SPINDLE.

time permits of a friction feed being used where desirable, the operator easily making the change from one to the other by simply turning a nut. As shown, a round plate having seven circles of steel pins is located above the spindle gear, and the pins engage with a steel pinion (involute cut) on the horizontal worm shaft, the speed of this shaft being varied by means of the knob shown below the lower wheel. This knob is fastened to a rod which extends through the center of the vertical feed shaft and has teeth cut on the upper end, which engage with a sliding rack to hold the steel pinion in any desired circle for fast or slow speed. These seven changes of feed may be quickly made while the drill is at work. The upper worm-wheel has its hub split, and by means of a ring nut can be locked to the vertical feed shaft for positive feed, or slightly released if friction feed be required. The automatic feed is tripped by disengaging a clutch shown on the end of horizontal feed shaft, which causes the upper worm to cease rotating. This feed mechanism is being applied by the Mueller Machine Tool Company, of Cincinnati, Ohio, to its radial drills.

A GANG DRILL.

The illustration herewith shows a special arrangement of 21-inch drills arranged in a gang. This particular combination consists of four 21-inch drills all mounted on one base which is in this case arranged for motor drive.

The first three machines are complete with wheel and lever feed, back gears, power feed and quick return to the spindle, while the last machine has a geared tapping attachment as well. Square oil-grooved tables are substituted for the round tables generally furnished. It is intended that this machine shall have a pump and proper piping for conveying the lubricant directly to the drills. The raising and lowering device on the tables is operated from the front.

In this particular combination of drills the machines are driven by cone pulleys mounted at right angles to the shaft driven by the motor, motion being transmitted to them through miter gears. This, however, can be modified and any other drive substituted to suit the requirements of the shop where the drills are to be used.

The arrangement of the drills themselves can be modified quite extensively, as the machines may be furnished with or without the tapping atttachment, with or without back gear, with or without power feed, and square or round tables, or one special continuous table. It is obvious that it is thus possible to arrange for official handling of manufacturing operations in any desired sequence.

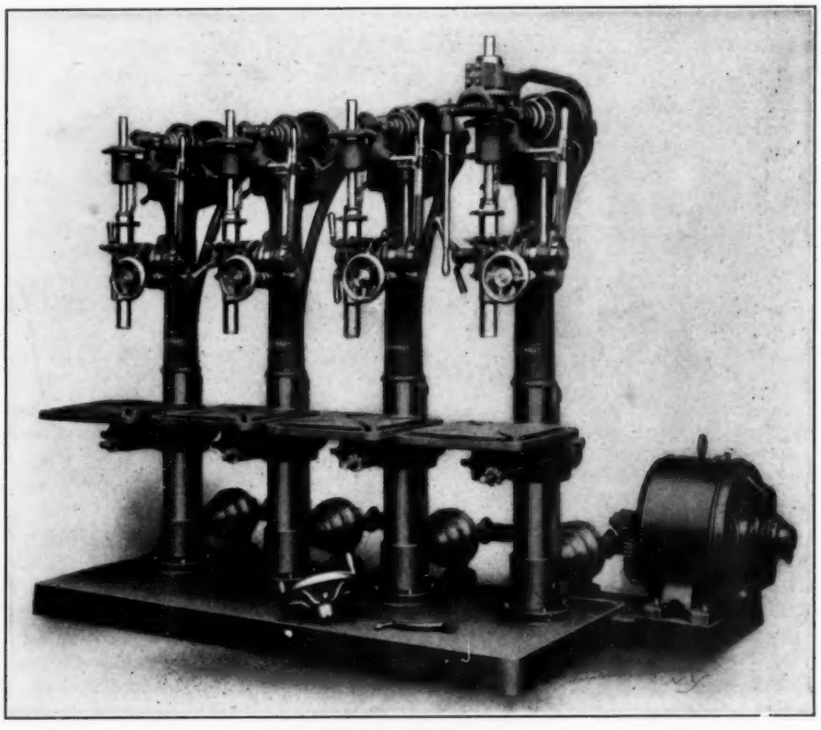
This machine is built by the Cincinnati Machine Tool Company, Cincinnati, Ohio.

A NEW LINE OF ELECTRIC MOTORS.

The Sprague Electric Company has just put on the market a new line of direct-current motors, called the Type D, ranging in capacity from 7½ to 105 horse-power.

Their general design and construction are such as to make a most attractive appearance, and only the best material obtainable and the most skilful workmen are employed in their construction. They possess features which afford copious ventilation of the windings, generous overload capacities, high efficiencies, durability, compactness and excellent variable-speed qualities.

The magnet yoke is cylindrical, with the pole pieces bolted to the inner side, brackets supporting the bearings being bolted to the ends of the yoke, which is of cast steel except for the larger sizes, in which it is of gray iron. The poles are built of laminated sheet-steel punchings, with projecting pole horns for spreading



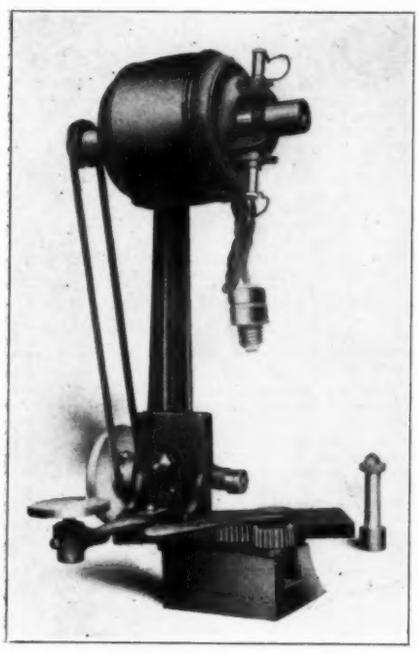
A GANG DRILL.

the magnetic flux and retaining the field coils. The armature cores are built up of thin notched punchings of annealed and japanned sheet steel. For the smaller sizes the punchings are keyed directly to the shaft and for the larger ones to a gray-iron spider. The commutator bars are of hard-drawn copper insulated with mica. The brush-holders are of the box type, in which the carbon slides in a metal pocket.

contact with the commutator being maintained by a flat adjustable spiral spring. The bearings have ring oilers.

MOTOR-DRIVEN PORTABLE GRINDER.

The half-tone shows a motor-driven grinder which is built for internal and external grinding in the lathe. When lathe centers are to be ground the compound slide is used, which, through means of the rack and pinion shown, is operated at a 30-degree angle with the lathe spindle without the use of a compound rest. This grinder can be placed on the tool-slide of any lathe, and may be used for internal grinding by mounting the small arbor and wheel in place of the larger wheel. Vertical adjustment is provided to bring the spindle up to the center line of the lathe spindle. The small rest is used for truing up emery wheels, sharpening cutters, saws, etc. Power is supplied to the motor from



MOTOR DRIVEN PORTABLE GRINDER.

the ordinary incandescent lamp socket. Provision is made for taking up the slack of the endless belt; for taking up the wear of the spindle, and for keeping the latter dust proof. This device is made by the Mueller Machine Tool Company, Cincinnati, Ohio.

A PIPE-BENDING MACHINE.

The pipe-bending machine which we described at page 338, Part 1, Vol. 28, has lately been improved. The segmental gear has been replaced by a gear train. The stand is now made telescopic, and has a head which permits the face-plate—where the bending is done—to be swung to a horizontal position. The machine bends pipe up to two inches diameter. It is built by Pedrick & Smith, Germantown, Philadelphia, Pa.

Personal.

Thomas S. Hanna, formerly with the Howe-Brown Company and Colonial Steel Company, is now associated with the Baldwin Steel Company, 107 John street, New York.

Hugo Diemer, consulting engineer, has opened an office in the Commercial Club Building, Indianapolis, Ind., and will devote his attention to production engineering, in which field he has been engaged for several years past.

A. H. Matson, who has been with the Morse Twist Drill Company, of New Bedford, Mass., for the last nine years, seven years as foreman of the cutter department, and the last two as designer of tools and special machinery, has resigned to accept a similar position with the Taft-Pierce Manufacturing Company, Woonsocket, R. I.

Obituary.

David Hammond, for many years at the head of the Canton Bridge Company, died at Canton, Ohio, December 27, aged seventy-five years.

James MacNaughton, president of the MacIntyre Iron Company, died of pneumonia at his apartments, 16 Central Park West, New York City, December 29. He was born in Albany, in 1851.

Matthew Patterson Wood, consulting engineer, scientist and author, died in New York, December 22. He published last year a work entitled, "Rustless Coatings; Corrosion and Electrolysis of Iron and Steel," which is considered authoritative. Mr. Wood was seventy years old. In the Civil War he was superintendent of motive power of the United States Railways, under Gen. Herman Haupt, and confidential agent for Secretary of War Stanton. He had been a member of the American Society of Mechanical Engineers since 1890, and contributed valuable papers to its transactions, on "Rustless Coatings for Iron and Steel." He leaves a widow and a sister, Miss F. A. Wood, Librarian of Vassar College.

Edward N. Andrews died December 29 at his home in Brooklyn, N. Y., after a protracted illness with cancer. He was a machinist of exceptional ability, whose early days were spent in the shops of the Boston & Albany Railroad, at Albany, N. Y. Some of the concerns with whom he was identified later were the Singer Sewing Machine Company, whose plant at Elizabethport he laid out, the Garvin Machine Company, for whom he designed quite a number of machine tools, and the De Laval Separator Company. The last years of his life were devoted to a shop of his own in Brooklyn, where he was actively engaged up to the time of his last illness. He attracted friends, not only by his superior mechanical skill, but also by his willingness to help those in need of assistance, being generous to a fault, this latter trait often being taken advantage of by unscrupulous parties. Mr. Andrews was sixty-eight years of age, and leaves a widow and two daughters.

Manufacturers.

John F. Hottman, Dubuque, Iowa, will erect a boiler factory.

The Baldt Steel Castings Company, Chester, Pa., will enlarge its plant.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago, Ill.

Automatic machines designed and built. Geo. M. Mayer, M.E., 1131 Monadnock Bl., Chicago, Ill.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N.J.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Engineers' Specialties Wanted.—Firm with large showrooms and extensive connections both among the jobbers and users throughout Great Britain want particulars of real live selling lines; American and British references given and required. Address A. Burgess Coults & Co., 41 Chapel st., Manchester, England.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of five directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company, in the Hallenbeck Building, 497-505 Pearl street, Borough of Manhattan, New York city, N. Y., on Monday, January 8, 1906, at 12 o'clock noon. Dated, New York city, December 5, 1905.

F. R. Low, Secretary.

For Sale.

For Sale—10-ton crane, 40 ft. span, rope drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co., Burlington, Iowa.

For Sale—A bargain; 90 in. gap second-hand steam riveter, 36 in. cylinder; good as new; Wm. Sellers & Co. make; price $500. Box 923, AMERICAN MACHINIST.

For Sale—1,200-light electric plant, consisting of 100 H.-P. Payne engine and 60-kilowatt Edison dynamo; perfect condition; low price to quick purchaser. Apply to Estate of Henry C. Miner, 194 Bowery, New York.

Business Opportunities.

To Manufacturers Engineers' Specialties.—Firm with large showrooms and extensive connections both among the jobbers and users throughout Great Britain want full particulars of real live selling lines; American and British references given and required. Address A. Burgess Coults & Co., 41 Chapel st., Manchester, England.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to

our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Position as foreman and designer on jigs, compound dies, experimental, etc.; 20 years' experience; references. Box 943, AM. MACH.

CONNECTICUT.

Mechanical engineer; technical graduate, with 17 years' experience on mill construction, mechanical handling, heavy machinery, power plants, etc. Box 964, AMER. MACH.

Young man, with 16 years' experience, desires change; has successfuly held responsible positions in drawing room and machine shop; has shown good results handling men; familiar with up-to-date, systematic methods. Box 963, AMERICAN MACHINIST.

ILLINOIS.

Postgraduate, M. E., practical machinist, a hustler and in methods up-to-date; inventor and specialist in solving difficult problems in machine design; 5 years chief designer; speak German as well as English; married, age 32, temperate and good character; guarantee satisfaction; South or Central preferred. Address "Designer," 281 Jackson Blvd., Chicago.

MARYLAND.

Designing draftsman (30), 9 years' experience; good reasons for desiring change; would accept responsible position with first-class firm. Address Box 944, AMER. MACHINIST.

NEW HAMPSHIRE.

Mechanical draftsman, 29, technical graduate, 5½ years' experience, would like to change; location no objection. Box 950, A. M.

NEW JERSEY.

Position wanted by experienced mechanical draftsman. Box 909, AMER. MACHINIST.

NEW YORK.

Mechanical draftsman wishes to change. Box 941, care AMERICAN MACHINIST.

Position wanted as forge shop foreman; 15 years' experience in the business. Box 935, AMERICAN MACHINIST.

As superintendent or manager, expert mechanic wishes position after January 1. Box 962, AMERICAN MACHINIST.

Desirous of position with good firm; neat tracer and detailer; two and a half years' experience. Box 942, AMER. MACHINIST.

Machine shop foreman, 12 years, age 38, thorough, practical and reliable, will engage at once. Box 961, AMERICAN MACHINIST.

A1 man, mechanical, inventive, business and executive ability, desires responsible position; Middle or Pacific States. Box 948, AM. M.

General foreman, responsible man, 36, experienced in high-grade duplicate general and mill machinery, expert machinist, wishes to make change. Pacific States preferred. Box 883, AMERICAN MACHINIST.

High-grade man (38) desires position of factory superintendent, manager, or other high-class position where mechanical skill, business and executive ability are required. Address Box 947, AMERICAN MACHINIST.

Designer, graduate M. E. (age 30); shop 2 years, 9 years office, special and small machinery, apparatus, jigs, fixtures and experimental work; practical and inventive man, hustler; location immaterial. Box 945, A. M.

OHIO.

Works manager for manufacturing plant; know the automobile business from A to Z. Box 955, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—A foreman, capable of handling men; good machinist only; give age, experience and references. Address Box 954, A. M.

Wanted—A first-class engineer for stationary engine; one capable of handling engine and directing fireman; we operate about 400 H.-P. and use generator and electric current for about 125 H.-P.; want a thoroughly competent man. Address Box 922, AMER. MACH.

Wanted—Foreman for machine department manufacturing automobiles; experience in this line not essential, but must be a first-class man able to produce results; prefer a married man not over thirty-five years of age; all correspondence confidential. Address Box 940, AMERICAN MACHINIST.

ILLINOIS.

Draftsman.—We have positions now open for draftsmen. Call or address Western Electric Co., Chicago, Ill.

MASSACHUSETTS.

Wanted—Operators for Gleason planers and gear cutting machines, also turret lathe men. Box 956, AMERICAN MACHINIST.

Machinists Wanted—We are increasing our force and need good all-around men for the building of special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

MICHIGAN.

Wanted—General foreman to take active charge of iron and steel working plant; good opportunity for right man. Box 530, Lansing, Mich.

Gear Planer Operator. — Wanted — Two operators experienced in running Gleason full automatic 36 in. gear planers; steady work; best pay. Industrial Works, Bay City, Mich.

Wanted—3 or 4 first-class, A1 automatic screw machine hands; to experienced men will guarantee steady position and highest rate of wages. Answer, with reference, to Box 85, Detroit, Mich.

MINNESOTA.

Wanted—Die and tool makers and bench hands, accustomed to small, accurate work; must be first class in every respect; highest wages. G. F. Kriesel, 2d st. and 5th ave., south, Minneapolis, Minn.

NEW JERSEY.

Wanted—A first-class mechanical draftsman; state experience and salary wanted. Box 881, AMERICAN MACHINIST.

First-class mechanical draftsmen wanted at once; must have experience in mill construction and power plant design; state age and salary expected. Box 958, AMER. MACH.

We are increasing our works and want applications for machinist foreman and machinists; in reply give details of experience, age and wages expected. The Edison Portland Cement Co., Stewartsville, N. J.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

NEW YORK.

Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

Wanted—First-class die and tool maker, as working foreman of machine and tool department. The Pritchard-Strong Co., Rochester, N. Y.

Practical draftsman, familiar with designing small tools, special machinery, patterns, etc. Answer, stating experience, Box 960, AMERICAN MACHINIST.

Wanted—Several first-class toolmakers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7, Syracuse, N. Y.

Wanted—Young man, good tracer, some knowledge of drawing; 1 or 2 years' experience; must have first-class references. Dodge Mfg. Co., 43 Dey st., New York.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 859, AMER. MACHINIST.

Wanted—Several A1 draftsmen; only those with 3 or more years' practical experience need apply. Engineer in Charge, Drafting Dept., General Electric Company, Schenectady, N. Y.

Wanted—Experienced draftsmen, first-class machinists, toolmakers, and gauge makers; give detailed experience, references, age and wages expected. Remington Arms Company, Ilion, N. Y.

Wanted—Two first-class toolmakers on combination dies and drawing dies for sheet copper, brass and sheet iron. Advise as to experience, references and wages expected. Box 929, AMERICAN MACHINIST.

Well-known young engine company wants general sales manager; also another man capable of testing engines, etc.; good salary to right man; must invest along with present owners. Box 959, AMERICAN MACHINIST.

Wanted—Electrical draftsmen; pay from $3.04 to $4.00 per diem. A competitive examination will be held for electrical draftsmen at the Navy Yard, Brooklyn, N. Y., January 4, 1906. For further information address "Commandant, Navy Yard, Brooklyn, N. Y."

Wanted—A strictly first-class foreman, thoroughly familiar with riveted work and must be first-class all-around mechanic; high salary paid for right man; excellent opportunity for advancement. Box 939, AM. MACH.

Wanted—Man of practical experience in the manufacture of small, interchangeable parts; gun work preferred; qualified to estimate on piece prices; must have good executive ability and judgment; state experience and salary expected. Box 926, AMER. MACH.

Wanted—Master machinist, $6.00 per diem, Naval Station, New Orleans, La. A competitive examination will be held for the above position at the Navy Yard, Brooklyn, N. Y., January 10, 1906. For further information apply to Commandant, Navy Yard, Brooklyn, N. Y.

Wanted—Man with technical training as draftsman and engineer, with experience in the design of special machine tools for economical production of interchangeable machine parts in large quantity; person with practical experience as a machinist preferred. Box 953, AMERICAN MACHINIST.

Draftsman to make working drawings from incomplete drawings, patterns, castings and finished parts; thoroughness and accuracy are essential; only applicants who desire permanent position will be considered; experience on pump or engine work desirable; location New York city; state experience and pay expected; give references. Address Box 951, AMERICAN MACHINIST.

OHIO.

Wanted—Foreman to take charge of about 20 vise hands in Cincinnati; must be well recommended, and had charge of vise work in tool shop. Address, with references, The Cincinnati Milling Machine Co., Cincinnati, O.

Wanted—A good designer who has had practical machine-shop experience as well as technical education, to work at the designing of new special tools and machines; some originality and inventive ability required; state age, experience and salary expected, also name references. Address Box 949, AMER. MACH.

Wanted—A superintendent; a small but growing concern, manufacturing a line of high-grade machinery, desires the services of a man from 30 to 35 years of age, to take charge of a factory employing about 15 men; must be an organizer and systematizer, with ability to turn out first-class work and handle men to advantage. Box 957, AMER. MACH.

PENNSYLVANIA.

Wanted—At once, expert Gleason planer hand; state experience. Box 965, AM. MACH.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMERICAN MACHINIST.

Wanted—Three first-class patternmakers, accustomed to air compressor and engine work. Write, giving full particulars as to experience, age and wages wanted, Bury Compressor Company, Erie, Pa.

A number of mechanical draftsmen; those with experience in electrical apparatus, generators or motors preferred; only first-class men need apply. Address Chief Draftsman, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa. P. O. Box 911.

VIRGINIA.

Wanted—Elevator erectors, with experience in erecting electric passenger and freight elevators. Address The J. B. Westbrook Foundry & Machine Company, Danville, Virginia.

WEST OF MISSISSIPPI.

First-class machinist, to work in repairing machine shop; prefer single, middle-aged man, with good habits and best reference. Mrs. Wm. Schmidt, 1193 Jefferson st., Jefferson City, Mo.

WEST VIRGINIA.

Wanted—Good lathe and vise hands; good wages; no labor trouble; increase of force. Answer, stating age and wages expected, Box 952, AMERICAN MACHINIST.

WISCONSIN.

A working foreman familiar with gas engine work, to take charge of erecting floor. Address, with references and salary expected, Box 946, AMERICAN MACHINIST.

To meet our constantly increasing requirements, we invite applications from first-class machinists and bench hands; those familiar with engine work preferred. Address, with references, Globe Iron Works Co., Menominee, Wis.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen, with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMER. MACHINIST.

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Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air
Ingersoll-Rand Co., New York.

Air Lifts
Ingersoll-Rand Co., New York.

Arbors
Morse Twist Drill & Mach. Co., New Bedford, Mass.

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See Roller Bearings.

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Kilbourne & Jacobs Mfg. Co., Columbus, O.

Barrels, Tumbling
Globe Mach. & Stamping Co., Cleveland, O.

Bars, Boring
Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
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Underwood & Co., H. B., Philadelphia, Pa.

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Belt Dressing
Cling-Surface Co., Buffalo, N. Y.
Dixon Crucible Co., Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

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Shultz Belting Co., St. Louis, Mo.

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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

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Davis Mach. Co., W. P., Rochester, N. Y.
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Hilles & Jones Co., Wilmington, Del.
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Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
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Swaine Co., Fred J., St. Louis, Mo.

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Wallace Supply Co., Chicago, Ill.

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Standard Welding Co., Cleveland, Ohio.

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Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chain
See Hoists, Hand.

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Am. Gas Furnace Co., N. Y. City.
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Buckeye Engine Co., Salem, O.
General Electric Co., New York.

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Landis Mach. Co., Waynesboro, Pa.
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Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.

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Williams Tool Co., Erie, Pa.

Bolts, Coupling
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National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Books, Mechanical
American School of Correspondence, Chicago, Ill.
Audel & Co., Theo., New York.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Modern Machy. Publishing Co., Chicago, Ill.
Tulley & Co., Henry C., St. Louis, Mo.
Wiley & Sons, Jno., New York.

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C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
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Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
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Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Stow Mfg. Co., Binghamton, N. Y.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.

Boring and Turning Mills *Continued*
Colburn Mch. Tool Co., Franklin, Pa.
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Harrington, Son & Co., Philadelphia, Pa.
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Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Bown Mach. Co., Battle Creek, Mich.

Brackets, Lamp
Standard Welding Co., Cleve., O.

Broaching Machines, Metal
Burr & Sons, John T., Brooklyn, N. Y.

Bulldozers
National Machy. Co., Tiffin, O.
Prentiss Tool & Supply Co., New York.

Cabinets, Oil
Montgomery & Co., New York.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Montgomery & Co., New York.

Calipers
Athol Mach. Co., Athol, Mass.
Mass. Tool Co., Greenefid, Mass.
Montgomery & Co., New York.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

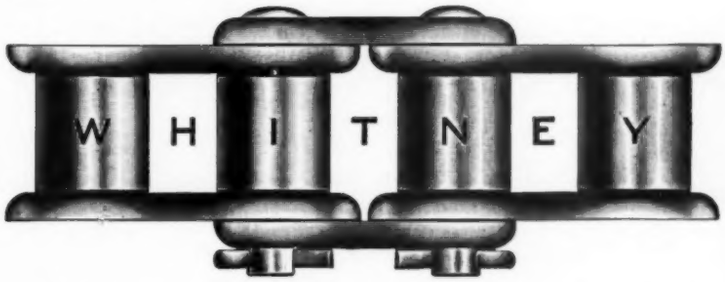
Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fuchs & Lang Mfg. Co., New York.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.
U. S. Foundry & Sales Co., South Norwalk, Conn.
Yale & Towne Mfg. Co., Stamford, Conn.

Castings, Motor
Harrison, H. K., St. Paul, Minn.
Steffey Mfg. Co., Philadelphia, Pa.

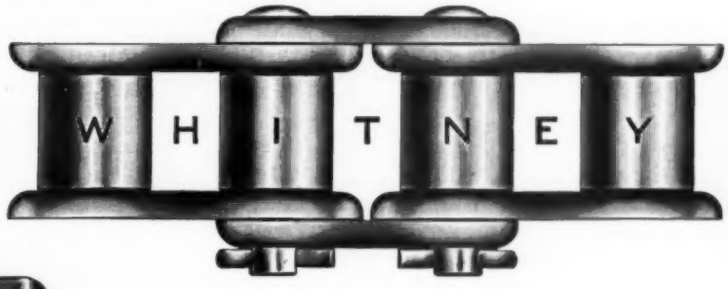
Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

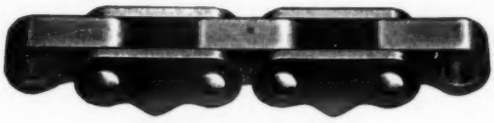
Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

"WIZARD" Chains and Sprockets—Patented

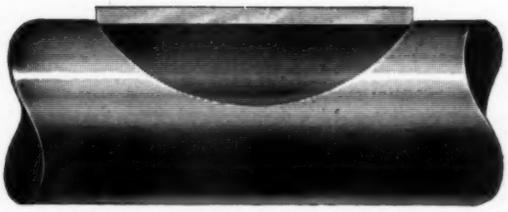


1906 Model "Whitney" Detachable Roller Chains—Patented

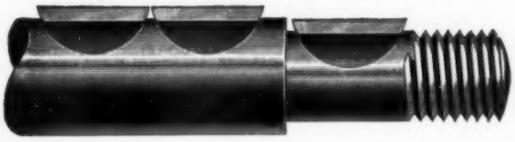




Block Chains



"Woodruff" Patent Keys



Three Popular Specialties

"Whitney" Chains
Hand (feed) Milling Machines
The Woodruff Patent System of Keying

THE WHITNEY MFG. COMPANY

HARTFORD, CONN., U.S.A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., Great Britain. Schuchardt & Schutte, Germany, Austria, Holland, Russia and Scandinavia. Fenwick, Freres & Co., France, Belgium, Italy, Switzerland, Spain and Portugal.

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Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Cullman Wheel Co., Chicago, Ill.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link-Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

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American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

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Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Montgomery & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Oneida National Chuck Co., Oneida, N. Y.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Westcott Chuck Co., Oneida, N. Y.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Davis Mach. Co., W. P., Rochester, N. Y.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Oneida National Chuck Co., Oneida, N. Y.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.

Circuit Breakers—*Continued*
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
American Tool & Mach. Co., Boston, Mass.
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Mchry. Co., New Haven, Conn.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Fulmer, Chas. F., Plainfield, N. J.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
International Steam Pump Co., New York.
Ingersoll-Rand Co., New York.
Mietz, August, New York.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R, Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Byram & Co., Inc., Detroit, Mich.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Cranes, Portable
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Nicholls, Wm. S., New York.

Crank Pin Turning Machine
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Crushers
Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Byram & Co., Inc., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Elliott Chemical Works, Newton, Mass.
Winkley Co., Hartford, Conn.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Ingersoll Milling Mach. Co., Rockford, Ill.
International High Speed Steel Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Burr & Sons, Jno. T., Brooklyn, N. Y.
Davis Mach. Co., W. P., Rochester, N. Y.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Robertson Mfg. Co., Buffalo, N. Y.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Goodell Mfg. Co., Greenfield, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, O.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York.
Francis Co., Hartford, Conn.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Globe Mach. & Stamping Co., Cleveland, O.
Kent & Co., Edwin R., Chicago, Ill.
Lutter & Gies, Milwaukee, Wis.
Niagara Mach. & Tool Works, Buffalo, N. Y.
Swaine Co., Fred J., St. Louis, Mo.

Dies, Sub-Press
Risdon, S. A., Waterbury, Conn.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.
Reliance Mach. & Tool Co., Cleveland, O.
Swaine Co., Fred J., St. Louis, Mo.

Dowel Pins
Winkley Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I., U. S. A.

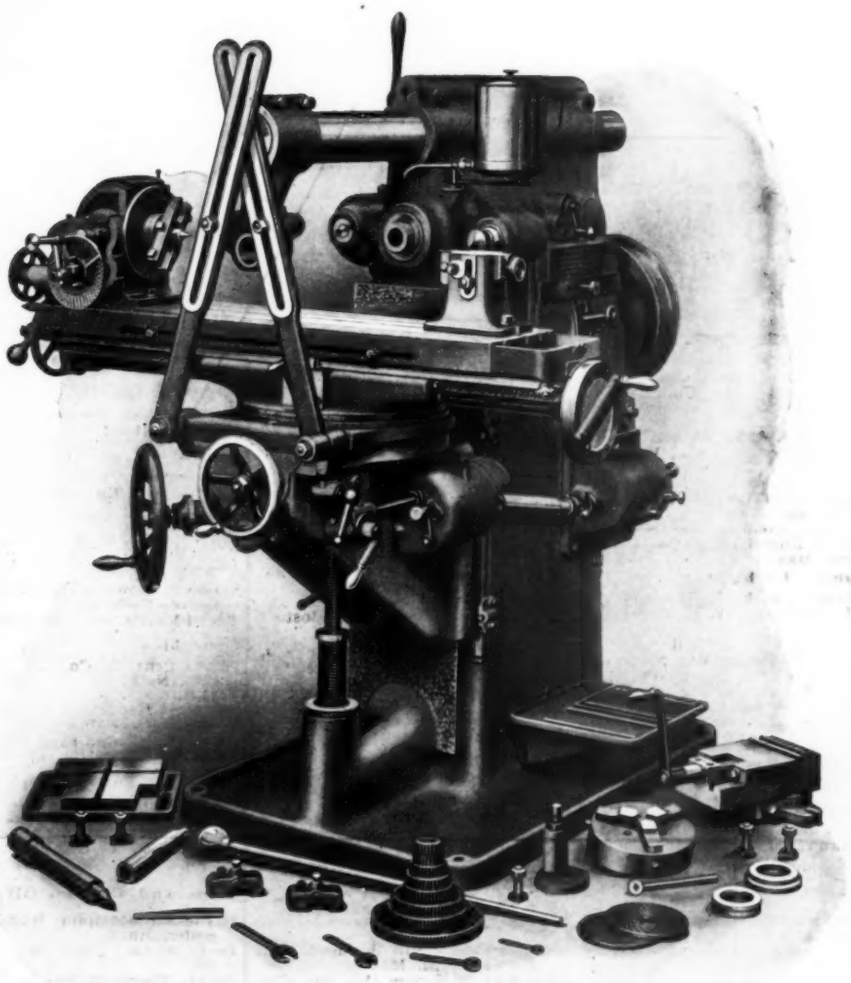
The Original Was a "B. & S."

1862

1862—1906

Representing a Period of Progress in

B. & S. UNIVERSAL MILLING MACHINES



1906

The essential factor in their success has been

Quality

It established and maintains a standard that is recognized.

Circulars describing the Milling Machines sent to any address.

See Page 197.

Drilling Machines, Bench *Continued*
Dwight Slate Mach. Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Patterson Tool & Supply Co., Dayton, O.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Dwight Slate Mach. Co., Hartford, Conn.
Fenn Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Stow Mfg. Co., Binghamton, N. Y.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Burke Mach. Co., Cleveland, O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.

Drilling Machines, Upright *Continued*
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knecht Bros. Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics' Mach. Co, Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers, Boat, Gauge & Drill Wks., John M., Gloucester City, Mass.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drills, Spindle
Three Rivers Tool Co., Three Rivers, Mich.

Drills, Twist
Montgomery & Co., New York.

Drying Apparatus
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.

Dynamos—*Continued*
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Dynamotors
Sprague Elec. Co., New York.

Electrical Supplies
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. Co., Chicago, Ill.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Employment Agency
Engineering Agency, The, Chicago, Ill.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Dickinson, Thos. L., New York.
Francis & Co., Hartford, Conn.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.
Reeves Pulley Co., Columbus, O.
Robertson Mfg. Co., Buffalo, N. Y.

Engines, Gas and Gasoline
Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mathews, Hugh, Kansas City, Mo.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Robertson Mfg. Co., Buffalo, N. Y.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
American Blower Co., Detroit, Mich.
Buckeye Engine Co., Salem, O.
Buffalo Forge Co., Buffalo, N. Y.
Garden City Fan Co., Chicago, Ill.

Engines, Steam—*Continued*
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Engravings
Springfield Photo-Engraving Co., New York.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., W. H., Wilkesbarre, Pa.

Extinguishers, Fire
Badger & Sons Co., E. B., Boston, Mass.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
Garden City Fan Co., Chicago, Ill.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Fillets, Leather
Cleveland Fillet Co., Cleveland, O.

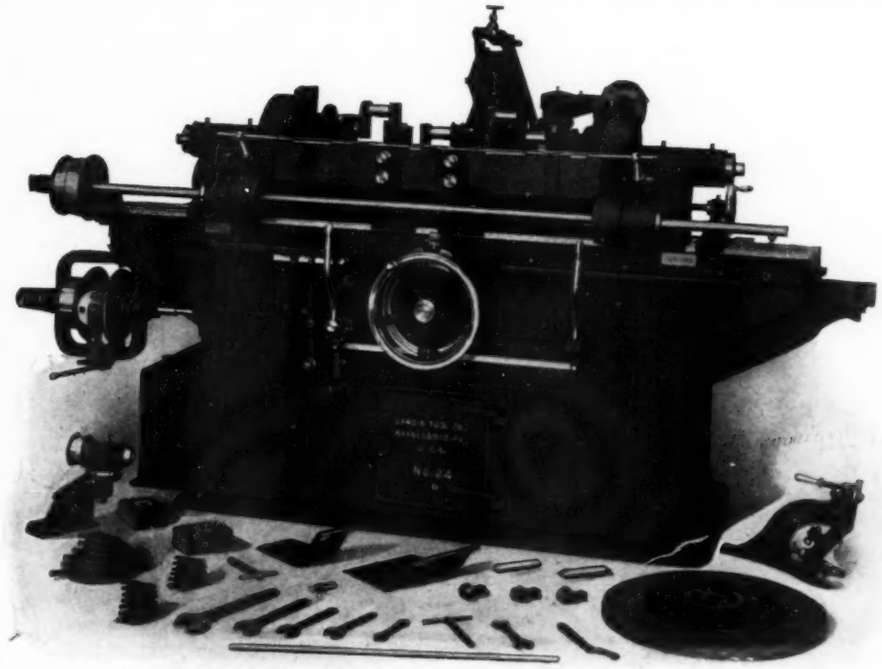
Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Burke Mach. Co., Cleveland, O.
Miner & Peck Mfg. Co., New Haven, Conn.
Ingersoll-Rand Co., New York.
National Machy. Co., Tiffin, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Lang Co., G. R., Cincinnati, O.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

For Automobile Manufacturing



No. 24 Crank Grinding Machine—16 inch swing; longest crank will drive 60 inches.

The only machine built specially for **Crank Shaft** grinding.

POINTS OF MERIT

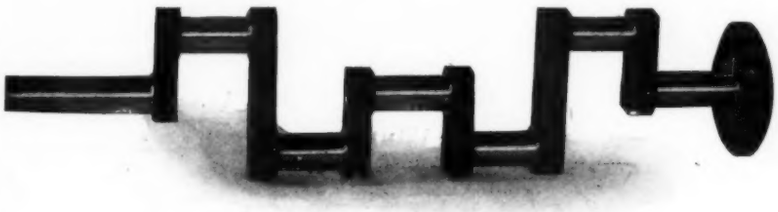
The highest degree of accuracy and refinement of crank shafts guaranteed.

Special adjustable fixtures for holding cranks where grinding wrists are provided.

No false or offset centers required.

Settings for throws indicated in either English or Metric graduations.

Reduces cost of production 50%. Give us an opportunity to convince you that this machine is indispensable for your work

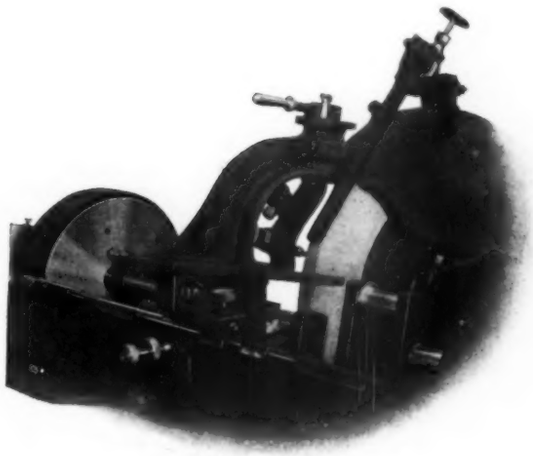


This Crank Shaft

is an example of Landis No. 24 Grinder's work. Parts ground four wrists, 1½ inches diameter, 3" long; 3 journals, 1¾" diameter, 3" 4", and 6" long, respectively 1-32" removed; time 1¼ hours.

Emery Wheel Truing Device

for truing face of wheel, also for truing the corners to an exact radius for grinding fillets. As regularly provided, it is for giving wheels correct shape for grinding fillets with radius up to one-half inch. As shown in illustration, it is clamped to top of stationary rest. Work need not be removed in order to true the wheel.



LANDIS TOOL COMPANY, WAYNESBORO, PA.

AGENTS—Walter H. Foster Co., 513 Williamson Building, Cleveland, Ohio. Walter H. Foster Co., 114 Liberty Street, New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Byram & Co., Inc., Detroit, Mich.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Mass. Tool Co., Greenfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Davis Mach. Co., W. P., Rochester, N. Y.
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Matchless Cigar Lighter Mfg. Co., New York.
Morse, Williams & Co., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Turley, H. G., St. Louis, Mo.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Mach. Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Turley, Harvey G., St. Louis, Mo.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Rivett-Dock Co., Boston, Mass.
Stow Mfg. Co., Binghamton, N. Y.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York
Rivett-Dock Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Cylindrical
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill
Burke Mach. Co., Cleveland, O.
Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.

Grinders, Tool—*Continued*
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Dwight Slate Mach. Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Lutter & Gies, Milwaukee, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Barnes Co., W. F. & John, Rockford, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Dayton Mach. & Tool Works, Dayton, O.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Montgomery & Co., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Patterson Tool & Supply Co., Dayton, O.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Robertson Mfg. Co., Buffalo, N. Y.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Stow Mfg. Co., Binghamton, N. Y.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wells & Sons Co, F. E., Greenfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.

The Works of R. Wolf at Magdeburg, Buckau, Germany,

BY EMILE GUARINI.

The firm of R. Wolf, founded in 1862, has been the first to construct, upon a plan entirely different from that adopted for the English and American types which were formerly the only ones in use, portable engines of over 200 and up to 360 horse-power, and it was the idea of Mr. Wolf to use superheated steam for these engines. Originally the portable engine was almost exclusively an agricultural machine, generally of low power. Mr. Wolf made it an industrial engine capable of meeting the requirements of a whole establishment, and since the very beginning has made also engines of a semi-fixed type, consisting of a portable mounted on iron supports and intended for stationary use.

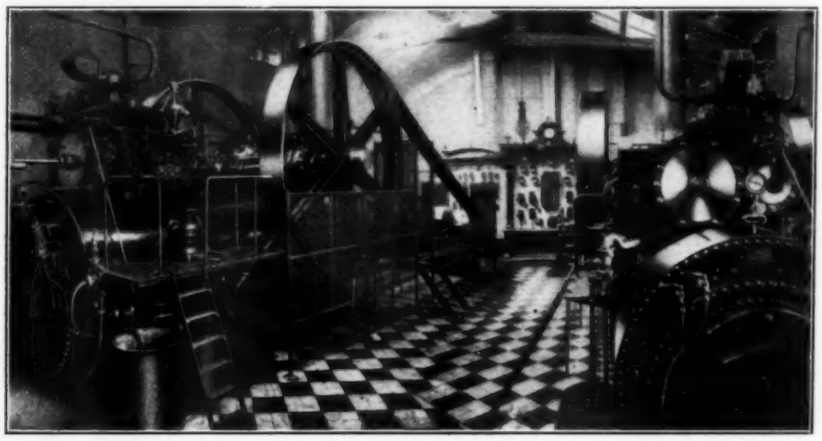


FIG. 1. TWO GENERATING UNITS.

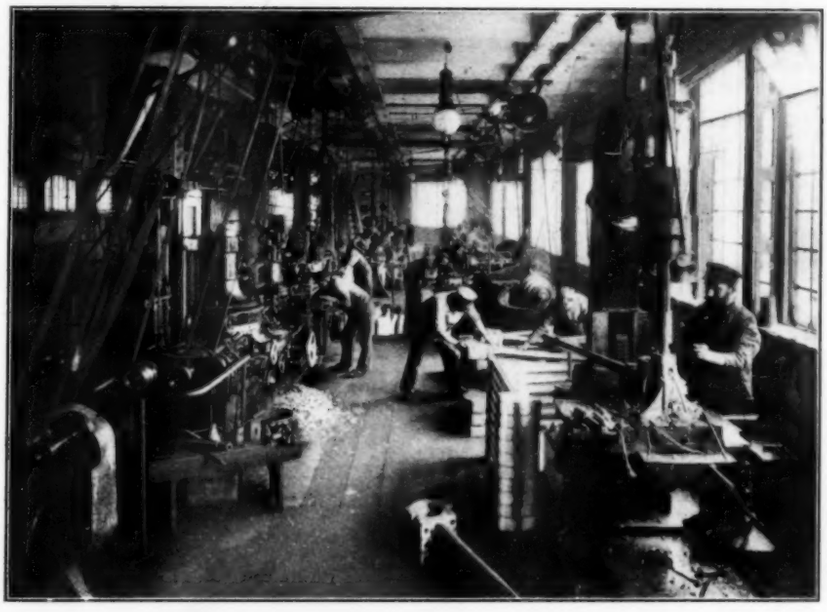


FIG. 2. VIEW IN MACHINE SHOP.

The works face the Feldstrasse for a length of 560 feet, and extend down to the Elbe, where there is a quay for facilitating the loading and unloading of products and raw materials. The Elbe furnishes a very economical means of communication; the works are also connected to the State and local railway lines, which run right up to and through the works in all directions. Furthermore fifty-six traveling cranes of a total capacity of about 410 tons, three traveling platforms of 60 tons, overhead rails and rotary cranes are installed in the works and depots.

Altogether the works cover an effective area of 331,000 square feet, comprising (besides the machine shops mentioned above) carpenters' shop, joiners' shop, etc. Extensive warehouses and depots are also at hand. The chief workshops are as follows: The turning shop, with a superficial area of 55,000 square feet; the boiler shop of 46,500 square feet; the assembling shop of 51,500 square feet. There are also a tool shop, blacksmith shop, fitters' shop, etc. Although of fairly old creation the works have not remained behind the times as regards tools, etc., and are fitted with the latest machine tools and general equipment, including cranes and elevators operated by electricity.

The motive power is not, as is nowadays generally the case, produced entirely in a central station; seven portables and semi-portables, and also a horizontal engine are scattered through the works and run upon the group-drive principle. A 60-horse-power steam engine and two 150 horse-power compound Wolf portables, working at 10 atmospheres, with a jet condenser, drive the six generators (250 kilowatt total capacity) which are contained in the central station, Fig. 1, and which furnish current to about 1,700 lamps, to clocks to the number of thirty-eight, and to motors (thirty with a maximum power of 170 horse-power), tools, cranes, etc.

The carpenter's shop comprises the general workshop and the pattern room, the latter having an electric elevator, and all the machines in the workshop are driven by means of one common motor.

The machine shop consists of various departments, and is provided with machines which carry out simultaneously the drilling, milling and planing of the joints of the covers and slide valves; one machine drills connecting rods, while two others, with four tools, machine the heads, as in Fig. 2. The connecting rods require only seven or eight hours to finish after leaving these machines, while the crank-shafts, which are made in a separate department, are worked with special tools which deliver them completely finished.

The boiler shop is arranged in such a way as to admit of hydraulic riveting being carried out easily. This department is provided with two cranes, one of which serves for the general handling of boilers in course of construction, while the other suspends them above the riveting plant. The boiler shop is also provided with an accumulator of 100 atmospheres, and has a 100-ton fixed riveting machine, as shown in Fig. 3; there are also three portable riveters, a hydraulic shearing machine, two chamfering machines, a heating stove, punch and rolling mills.

The pistons are of special design, formed of segments, which also form a spring on all sides without gripping. The cylinders pass to a separate workshop, Fig. 4, where they are cleaned off and adjusted, and the slides and inner surfaces are tested under high pressure. The erecting shop is divided into two parts, in the first of which, Fig. 5, the boilers are fitted with the parts to be incorporated with them, such as the cylinders, journal frame, etc.

In the second section the large and small mountings are fitted. The supports,

the bearings, the connecting rods, the eccentrics, and then the shafts are all adjusted, until completely fitted out ready for testing. In the tool shop there are prepared most of the tools and templets, by means of which the work is carried out.

The forge shop is provided with several steam hammers, and has fourteen furnaces, and a special furnace for heating small parts. In the assembling shop the piping is adjusted after testing under high pressure; there are numerous drilling, boring and other machines here.

In the paint shop the engines are given their final coats of paint and varnish. All parts and engines which do not require to be shipped immediately are sent to a storehouse, which is provided with a traveling hydraulic crane, with two movable 25-ton jacks, and two 5-ton cranes. Finally, upon the grounds, there are also the lunch rooms, wardrobes, etc., for the workmen, and also a special department occupied by a private fire department.

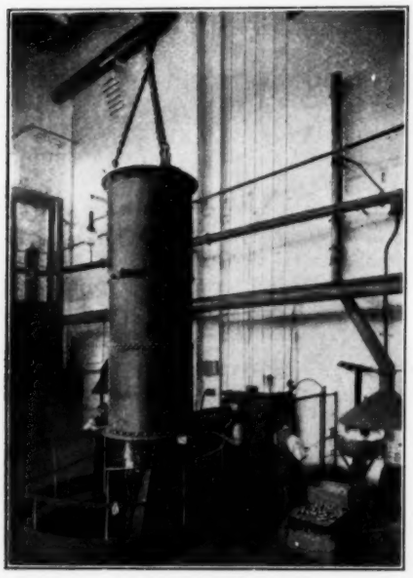


FIG. 3. BOILER RIVETING.

The offices of the technical and commercial departments are connected to the workshops, and also to each other, by fifty-seven lines of private telephone wires, all of which meet at a central distribution board. A chronometer is also provided for regulating the thirty-eight electric clocks distributed throughout the various workshops.

The awakening of the steam railroads to the serious competition of the electric railways has, on the Erie Railroad, taken tangible shape, inasmuch as that company will soon let contracts for the construction of a third track from Binghamton to Corning, N. Y., seventy-six miles, to be operated by electricity. This is intended to take care of the local traffic and leave the main tracks free for through trains and freight. The Erie has also further electrification projects under consideration.

A Tale of the Old-Time Boiler Shop.

BY T. J. WRIGHT.

"Boiler-makin' ain't what it used to be," sighed a grizzled old boiler maker, as he took a firmer grip on his short-stemmed pipe and gazed reflectively through a smoky haze that hung like a halo over his head.

"The old-time shop, with its hand flangin', hand rivetin', screw punchin', an' the like has, along with a lot of other good, old-fashioned institutions, just about been crowded off'n the earth for good an' all. Here an' there you may still find some old-timer, who ain't fully tumbled to what's happened, strugglin' on against what folks nowadays call the 'march of progress', an' tryin' by muscle an' main

FIG. 4. THE CYLINDER FLOOR.

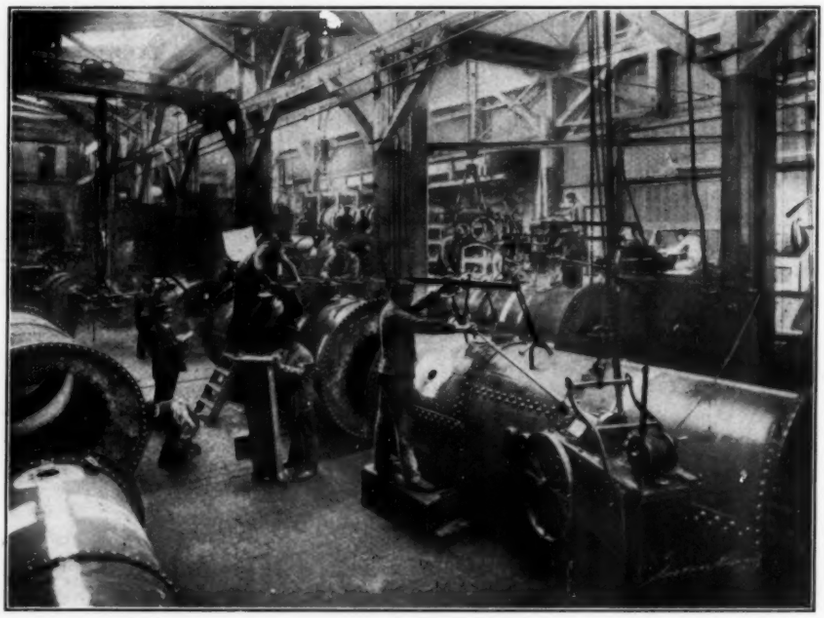


FIG. 5. THE ERECTING FLOOR.

"Back in the days when I served my time we used to build boilers in boiler shops, but it ain't done that way any more. For that matter, they don't build boilers; it's steam 'generators' in 'units' now, and the work is done in factories instead of shops. At least, that's the notion I get from the talk I hear these days.

strength to build boilers in competition with the factories where they rivet 'em up with hydraulic sewin' machines. But it's no use. The Lord knows, an' they'd ought to, that they ain't got no more show in the game than a pet poodle 'd have in a free-for-all dog fight.

"In the old days it took boiler makers

to build boilers—men who'd served their time at the trade an' could do any part of a job from heatin' rivets to layin' out. But it's different now. Just because a man happens to be workin' in a boiler factory's no sign he's a boiler maker. One man runs a rivetin' machine, another manages a wind-jammin' tool, still another sets tubes, an' not one of the bunch, outside of the foreman mebbe, could any more lay out an' build a boiler than he could turn handsprings over the moon. Workin' that way, of course, a man has use for his hands, but mighty little for his head. The thinkin' seems to be done by the machines. With plenty of new-fangled tools for every sort of work it's all dead easy; but such men wouldn't have cut much mustard in my old handshop.

"It used to be, when special jobs turned up requirin' tools we didn't have, we simply got busy an' invented ways an' means of doin' the work with such as we did have. Emergencies of that sort call for the exercise of a whole lot of common horse-sense that ain't naturally the product of treadmill minds.

"Take that tank job, for instance—the time when, by doin' a thing the way it ain't commonly done, I beat old Grimes an' his shop gang to a seal-brown finish, an' got the contract for movin' them four big steel tanks for the Sunlight Oil Company.

"It was comic the way Grimes took on when he found out what my bid was. Why, he pretty near had a fit; and there's no doubtin' but what he'd have tore his hair if he hadn't been as bald as a Mexican dog, which he surely was. Anyhow, he put up an awful roar about my takin' the job so cheap—said it was just such ignorant fool figgerin' that was ruinin' the business, an' a lot more uncompliment'ry talk like that.

"Calculatin' cost accordin' to the way he proposed to do the work, it ain't much wonder he thought my bid was a looney proposition.

"You see it was like this: There was a narrow neck of land runnin' parallel with the east shore of the river—this, by the way, was over on the Mississippi—that had once been an island; but a sand bar fillin' in at its upper end had connected it with the mainland, formin' a sort of peninsula. Between it and the shore proper lay a narrow bay, which, not bein' bridged, could only be crossed by means of boats.

"In them days most of the freightin' was done by steamboats, so the oil company had built their tanks at the foot of the peninsula, where it was handy to load an' unload direct from the landin'. Later on, when the railroads come in, an' steamboatin' got sort of 'passay', the company concluded to move the tanks over to the east shore an' set 'em up near the railroad tracks, about two miles below town.

"Now, it was natural enough to suppose the job would involve cuttin' the rivets an' takin' the tanks down a sheet at a time. The plates could then be scowed across the bay, loaded on the cars an' hauled to the new location; or they might be piled on a barge, towed down the river an' carted overland from the landing. That, at least, would be the regular, ordinary an' orthodox way of tacklin' such a job, an' Grimes pitched in an' figgered accordin'.

"Knowin', of course, that I'd be hot-foot after the contract, too, he got right down to it an' figgered almighty close, addin', for profit, only scant days' wages to actual cost. Somehow it never 'pears to strike unthinkin' folks that there's more'n one way of doin' things. Mebbe in their school days they've wrote in their copy-books a hundred times the sayin' that 'Circumstances alter cases," but the real meanin' of it all never seems to soak in an' settle in their heads. An' so they dub along a-doin' things the way they've learned to do 'em, like backwoods people, who still ride horse-back to mill, with a stone in one end of the sack to balance the grist.

"Well, as I was sayin', Grimes, after carefully estimatin' the cost, an' allowin' only the least possible time under the most favorable circumstances for doin' the work, put in his bid for $800, includin' an agreement to have it all finished within eight days. Now, it so happened that the oil company had a big shipment of oil on the road, due to arrive in about four days, an' they were on that account terrible anxious to have them tanks ready as soon as possible—intimated, in fact, that the party offerin' the quickest job would get the contract, even at a higher price. All of which 'peared to be favorin' to Grimes, for he had five strappin' boys, all journeymen boiler makers, an' he could muster a bigger force of skilled men than I could. I knew, therefore, if I underbid him, I'd not only be liable to lose money, but would probably fail to finish the work in the time he'd specified. Meantime, Grimes was blowin' 'round how he had me skinned, an' he actually turned down a good repair job for the sake of bein' ready for this contract, which he considered as good as landed.

"To tell the honest truth, it begun to look to me mighty like as if he'd make good; but all the same, I couldn't afford to lay down an' own up I was beat. So, after dinner, I rowed across the bay to look over the situation and see if I could pick up any points of advantage before submittin' my offer.

"'Here', says I, viewin' the task before me, 'right here's where I've got to do some fast wit-work or lose out.'

"All at once, while I stood there whittlin' an' thinkin—an' mebbe you've noticed that good ideas are right often mixed with whittlin's—all at once a thought struck me.

"'Eureky!' I yelled, 'I've got it. It's as easy as shovelin' smoke with a dust pan.'

"A scheme for doin' the job otherwise than I'd been figgerin' on suddenly dawned on me, an' in a twinkle the whole thing was as plain as a coon track in soft mud. You better b'lieve I didn't lose much time in gettin' back to the shop, an' as soon as I got there I grabbed a pen an' wrote a proposition like this:

"'Sunset Oil Co.

'Gentlemen—I hereby propose to take down the four tanks specified in your letter, remove them from their present location and erect them on the new site, complete, for $500. I also agree to have them finished and ready for use within three days from receipt of order; and failing to do so, I further agree to forfeit entire contract price. 'Yours truly,

'WM. BLAKE.'

"Did I get the order? Why, man, the manager like to fell down stairs in his hurry to get over to my shop with it. He was a little dubious, though, about my bein' able to put the job through inside the time limit; but at the same time, he knowed that whatever shortcomin's Bill Blake might have, flunkin' an agreement wasn't one of 'em.

"How did I——? Oh, that was easy. It was like drawin' money on a lottery ticket. You see, it wasn't far to the river from where the tanks stood, an' a sandy beach sloped up from the water almost to their foundations; a circumstance that was highly favorin' to my plans. Within an hour from the time the order was given my men were at work, an' by night they had the openings in all the tanks closed tight. After supper we went back again to tackle the job by moonlight. With the aid of a stern-wheel tow boat an' a lot of ropes an' tackle blocks, it proved an easy matter to tip the tanks over an' roll 'em down the sandy slope into the water, where they floated as nice as you please. Hookin' 'em up tandem, we towed 'em down stream, an' beached 'em on the shore in a handy cove. The rest of it was simple as shoutin'.

"Next day, with ropes an' guys, an' a house-movin' windlass, we rolled the tanks in, barrel fashion, over a sand bar an' across a stretch of level bottom land to their location on the switch tracks. Once there, it was only a matter of upendin' 'em on the foundations, which we did in jig time, with the help of a home-made derrick. To the paralysin' astonishment of everybody, includin' Grimes an' his outfit, we had all four tanks set up an' the job completed before night, havin' finished it in less than thirty hours from the time we got the order.

"On reck'nin' up, I found that after deductin' all expenses we had cleaned up a net profit of a little more 'n $400; an' it was done so easy, it looked like a shame to take the money. What did Grimes say? What he said ain't properly repeatable, but

it was pretty generally allowed that the heat of his remarks had a good deal to do with the terrible hot spell that set in about that time."—*Power.*

English Beam-End Milling Machines.

The firm of John Holroyd & Co., Ltd., Milnrow, near Rochdale, has been making a number of large machines especially designed for milling the ends of beams of various sections. We illustrate two of these tools. The machine shown in Fig. 1 has been erected at a large carriage- and wagon-building works at the Midlands, and is intended to mill the ends of twelve channel beams simultaneously, the maximum dimensions being 12 inches wide by 3 inches deep, the maximum length that can be milled being 68 feet. The ends may be cut straight down or milled at an angle as required. An 80-foot bed is built up in sections which are tongued and firmly bolted together, the bed being 3 feet 6 inches across the face by 9 inches high. On it are mounted four large cutter-heads, one of which is shown in Fig. 2, and four powerful clamp vises to hold the work, one of these being illustrated in Fig. 3. The cutter-head of the frames can be moved along the bed by means of a rack and pinion with reversing bevels, worm and worm-wheel, and handle or belt. All these parts are placed at the bottom of the frame. The motion, too, is controlled by a forked handle on the lower part of the frame. Each frame is strongly ribbed and is about 6 feet high. On its front face is mounted a slide which carries the cutter. This slide has a vertical movement of 2 feet, and is balanced by weights at the back of the head. On the top of the frame are fixed a 10 horse-power electric motor and the driving and feed gear. The motor runs at 800 revolutions a minute, and drives the cutter spindle through spur gear, bevels and vertical splined shaft, the ratio of the gearing being 45 to 1. Consequently the cutter runs at about 17¾ revolutions a minute. The cutter spindle is of 5½-inch steel, and is driven by a central wheel 25½ inches diameter. The spindle bears double conical bushes, 9½ inches diameter by 9 inches long, these being keyed to it and having adjustment for wear. They run in gun-metal bearings. The cutter mandrels are one at each end of the spindle, and are 2½ inches diameter. They carry the shaped cutters, the maximum dimensions of which are 12 inches diameter by 12 inches long. The outer end of each mandrel runs in a bush which is carried in a bracket fixed to a 6½-inch-diameter steady arm. Vertical feed to the spindle slide is obtained by a belt with worm-gearing and screw. Quick return by power and hand-adjustment by a hand-wheel in front of the slide are also supplied. For milling down the channels at an angle a slow, powerful feed is given by a screw with bevel and worm-gearing placed inside the frame and driven by a spindle at the upper part of the frame. The spindle is connected by change wheels to the feed shaft, driving the vertical screw of the spindle slide. The change wheels are supplied for obtaining the dif-

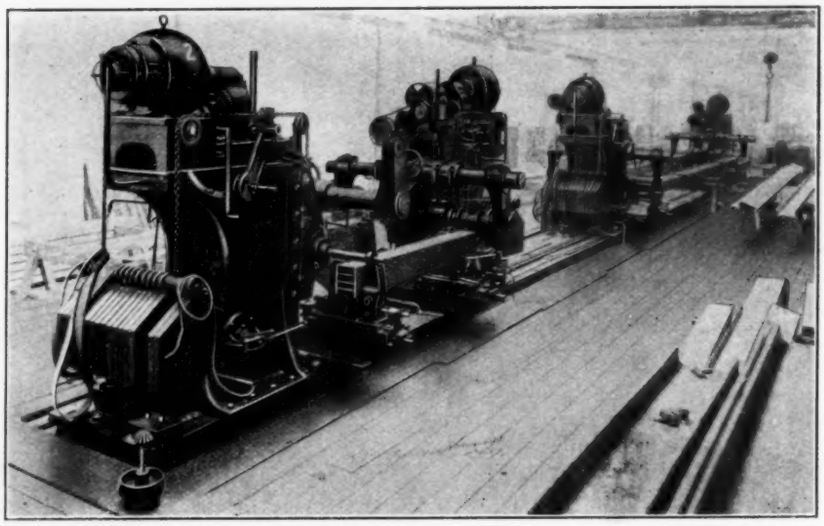


FIG. 1. LARGE MACHINE FOR MILLING ENDS OF BEAMS.

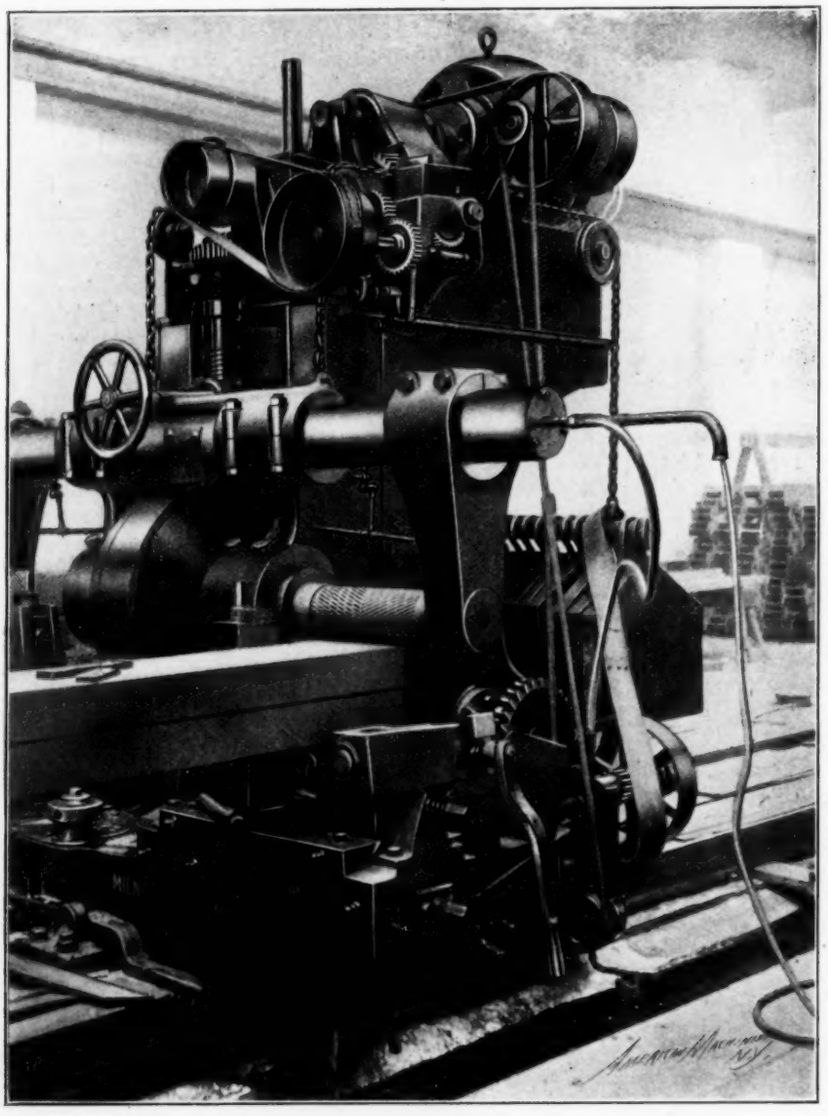


FIG. 2. HEAD OF BEAM-END MILLING MACHINE.

ferent angles desired. A knock-off arrangement is provided for the feed motion and also for use when reversing quickly by power. Each head has the usual pump, water-tray and other fittings, and the starting-switch and resistance for the motor are placed inside the frame and away from all handles.

Another machine built by the same firm is intended to mill the ends of beams of maximum sections of 18x4 inches, and will operate on both ends at once on the maximum length of 70 feet. Six such beams can be machined together. Tables are also supplied on which may be bolted girders that have to be milled at an angle. In fact, the machine is arranged to mill a 4-foot beam at an angle of 45 degrees and an 8-foot beam at 60 degrees. Generally speaking, the design is the same as that already described, except as regards the heads. The tool is built up on two stiff beams, which are coupled together by 1½-inch bolts, a double rack running the whole length. Figs. 4 and 5 give illustrations of the heads. Each is mounted on a cross-slide which is, of course, carried by the beams. On the front of each cross-slide is an extension, and on this is mounted the vise for carrying the work. Each head has a base-plate on which are mounted two box pillars secured together at the top by means of a plate, this carrying a 15 horse-power 200-volt variable-speed electric motor and the main driving gear. The speed of the machine is 660 to 800 revolutions a minute. On one of the pillars an angular head is bolted, this carrying the long slabbing cutter. This is set at an angle so that the whole width of the cut does not come on the beam at once. The slabbing cutters are 5 inches diameter by 14 inches long, with a 2½-inch hole, their maximum speed being 35 revolutions a minute. The feeds are 9-11 inch (0.818182 inch), 1 inch and 1 2-9 inch (1.222222 inch) a minute. The upper head carries two brackets for horizontal spindles, which in turn carry two shaped end-mills to machine the edges of the beam. These end mills are 7 inches diameter by 4 inches long, with 3½-inch hole, and run at a maximum speed of 25 revolutions a minute. All three cutter spindles are driven by phosphor-bronze wheels and hardened-steel worms from shafts driven through spur and bevel gear from the motor. The spindles run in bronze-capped bearings, and the thrust on the driving worms is taken by ball races. The cross-feed by screw and nut is operated by a feed cone in one of the pillars. Quick return is provided by power at a rate of 33 inches a minute. One head has power and hand traverse motions along the beams, and, beside the two swivel vises on the two heads, a central vise with table is also supplied and can be racked along the tool. Finally, this machine occupies a floor space 11x80 feet, and its weight is 24½ tons.

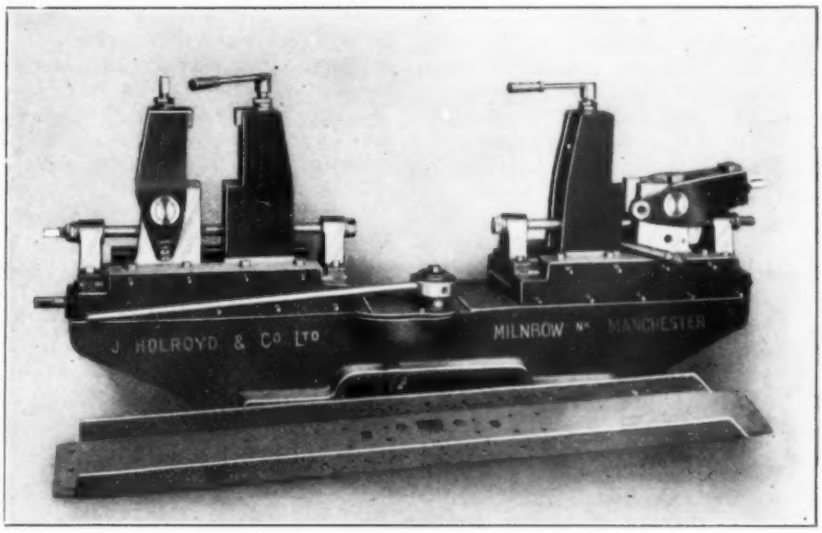


FIG. 3. CLAMPING VISE FOR BEAM MILLING MACHINE.

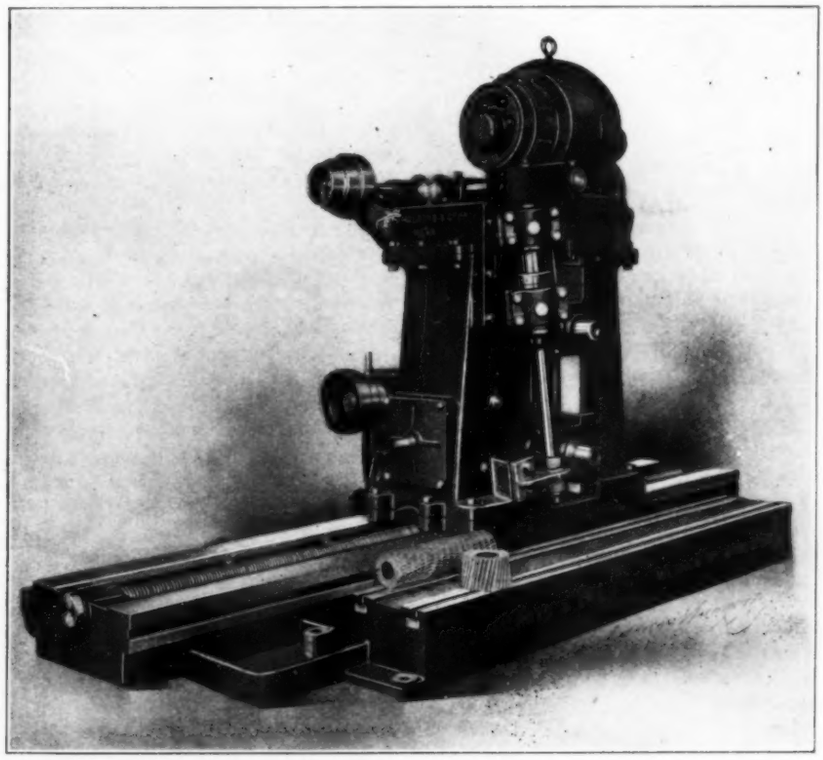


FIG. 4. HEAD OF BEAM END MILLING MACHINE.

London, England. I. W. C.

United States Consul Smith, of Victoria, British Columbia, reports a somewhat unique plan of profit-sharing. An electric company there, after computing net earnings and paying a dividend of 4 per cent. upon its stock, then divides the balance remaining, giving two-thirds of this to the stockholder and the other third to the employees; and a peculiarity of the plan followed is that every employee, from the highest to the lowest, regardless of the salary or wages he receives, gets the same bonus per year, which has amounted to $35 to $40. The plan works well.

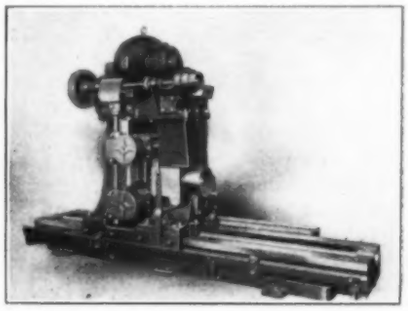


FIG. 5. HEAD OF BEAM END MILLING MACHINE.

History of the Standard Weights and Measures of the United States.*

BY LOUIS A. FISCHER.

The subject of weights and measures is one of such great interest and importance and is attracting so much attention in this country and in England at the present time that a short account of the steps taken to secure uniformity in the United States is deemed an appropriate subject to bring to the attention of this convention.

The attention of the United States government has long been directed toward securing uniformity in this country, and in the effort to secure international agreement in weights and measures it has always shown the greatest interest. The history of the original Confederation of States and of the constitutional government of the United States is full of evidences of the perplexities arising from the diversity of weights and measures throughout their jurisdiction and of the desirability of a uniform system.

The weights and measures in common use in this country at the time of the American Revolution were all of English origin and were in use in England at that period. The principal units were the yard, the avoirdupois pound, the gallon and the bushel. More or less authentic copies of the English standards of the denominations mentioned had been brought over from time to time and adopted by the different colonies. Divergencies in these weights and measures were, however, quite common, due, no doubt, to the fact that the system of weights and measures of England was not itself well established, and hence the copies brought to this country were often adjusted to different standards.

That this condition was recognized very early is made evident by the Articles of Confederation which contained the following clause: "The United States in Congress assembled shall also have the sole and exclusive right and power of regulating the alloy and value of coin struck by their own authority, or by that of the respective States—fixing the standard of weights and measures throughout the United States." This power was transferred to Congress by the Constitution of the United States in article 1, section 8, the language being as follows: "The Congress shall have Power . . . . To coin Money, regulate the Value thereof, and of foreign Coin, and fix the Standard of Weights and Measures."

While Congress was not slow to take action in regard to coinage, it seems not to have been inclined to come to a decision in regard to weights and measures, though apparently willing enough to consider the subject. Washington, in his first annual message to Congress, January, 1790,[1] stated that "uniformity in the currency, weights, and measures of the United States is an object of great importance, and will, I am persuaded, be duly attended to." In accordance with Washington's suggestion, the matter was referred to a select committee of the House of Representatives, with instructions to prepare a bill, and it was also ordered that the matter be referred to the Secretary of State to prepare and report to the House a proper plan for establishing uniformity in the weights and measures.[2] Jefferson was then Secretary of State, and in response to the above request made a report, in which he proposed two distinct plans. The first was substantially to "define and render uniform and stable the existing system . . . . to reduce the dry and liquid measures to corresponding capacities by establishing a single gallon of 270 cubic inches and a bushel of eight gallons, or 2,160 cubic inches . . . .." The second plan was "to reduce every branch to the same decimal ratio already established for coin, and thus bring the calculations of the principal affairs of life within the arithmetic of every man who can multiply and divide plain numbers."[3]

No action was taken, however, by the House, and in his second message to Congress, on December 8, 1790, Washington again called the attention of that body to the importance of the subject.[4] A few days later the House ordered that the report of Jefferson, referred to above, be communicated to the Senate. On March 1, 1791, the Senate committee to which the matter had been referred reported that it would not be eligible to make a change in the weights and measures, as a proposition had been made to the French and British governments to obtain an international standard.[5] This report was accepted and the matter rested there, although Washington, on October 25, 1791, repeated his former recommendations in his third annual message to Congress, in the following language:[6]

"A uniformity in the weights and measures of the country is among the important objects submitted to you by the Constitution, and if it can be derived from a standard at once invariable and universal, must be no less honorable to the public councils than conducive to the public convenience."

A week later the Senate appointed a committee to take into consideration the subject of weights and measures. The committee reported on April 4, 1792, recommending the adoption of the second plan proposed by Jefferson, which was an entirely decimal system. Again no definite action was taken. The matter was considered in a desultory way by Congress from time to time, but no agreement was reached, notwithstanding that the repeated recommendations of Washington were followed by those of Adams. A sufficient explanation for the disinclination of Congress was the difficulty of agreeing upon a plan.

The Fifth Congress, second session, in 1799, passed an act ordering that the surveyor (of each port of the United States) shall from time to time, and particularly on the first Monday of January and July in each year, examine and try the weights, measures and other instruments used in ascertaining the duties on imports with standards to be provided by each collector at the public expense for that purpose; and when disagreements and errors are discovered he shall report the same to the collector and obey and execute such directions as he may receive for the correction thereof, agreeably to the standards aforesaid.[7]

This was the first act passed by Congress in regard to weights and measures, but in view of the fact that no standards had ever been adopted, the legislation was not put into operation until about thirty-five years after its passage, when certain standards, which will be referred to later, were adopted by the Treasury Department.

After the war of 1812, the question of uniformity in weights and measures was again brought to the attention of Congress, and in 1819 a committee of the House of Representatives proposed to adopt absolute standards conforming to the weights and measures in common use; to obtain through a commission copies of the yard, the bushel, the wine gallon and the pound supposed to conform to those in common use in the United States; to preserve these standards and to distribute copies of them; to compare the length measure with the length of the second's pendulum, and also with that of an arc of the terrestrial meridian; to connect them by determining the weight of a certain bulk of distilled water, and to define the bushel and the gallon by the weight of water which they contain.[8] No further record of the report is found, and it may be assumed that no action upon it was taken. The Senate had, by a resolution adopted March 3, 1817—two years prior to the above report—requested the Secretary of State to prepare and report a "statement" relative to the regulations and standards for weights and measures in the several States and relative to the proceedings in foreign countries for establishing uniformity in weights and measures, together with such propositions relative thereto as might be proper to adopt in the United States.

*An address delivered before the First Annual Meeting of the Sealers of Weights and Measures of the United States at the Bureau of Standards, Washington, D. C., 1905.

[1] Messages and Papers of the Presidents, 1, p. 66.

[2] Congressional Register, 3, p. 106.

[3] Journal of the H. R., Childs & Swaine, p. 106.

[4] Messages and Papers of the Presidents, 1, p. 83.

[5] Journal of the Senate, p. 143; John L. Fenno.

[6] Messages and Papers of the Presidents, 1, p. 108.

[7] Statutes at Large, 1, p. 643.

[8] Executive Doc. No. 73, 30th Cong., 1st sess., Senate.

John Quincy Adams was at that time Secretary of State, and four years later—namely, on February 22, 1821—he submitted an elaborate report to the House of Representatives, in which, among other recommendations, the following are found:

(1) To fix the standard with the partial uniformity of which it is susceptible for the present, excluding all innovations.

(2) To consult with foreign nations for the future and ultimate establishment of universal and permanent uniformity.

As before, Congress took no action, probably because the situation at that time was extremely complicated. Neither the metric system in France nor the system in common use in England was well established. In France the law making the metric system compulsory had been repealed, and the metric system was in use side by side with the ancient weights and measures, thus producing endless confusion. In England the situation was not much better; the ale gallon of 282 cubic inches and the wine gallon of 231 cubic inches were both in use until 1824, when the new imperial gallon, containing 10 pounds of water, and of a capacity of about 277¼ cubic inches, was adopted, together with the bushel of 8 gallons. Neither of these measures was in use in this country, and hence the United States could not at that time adopt either the system in use in England or the one in France without introducing radical changes in the weights and measures already in use, nor was there at that time any positive assurance that either the English or the metric system would be permanent.

While Congress had been considering the matter, most of the States had, independently of one another, secured and adopted standards. Most of the standards thus adopted were brought from England; nevertheless, standards of the same denominations differed widely among themselves, thus perpetuating confusion in the commerce between adjacent States.

Though confusion in commercial transactions might be overlooked, uncertainty in regard to the coinage could not be tolerated, and on May 19, 1828, a certain troy pound was adopted as the standard for coinage by Congress in an "Act to continue the Mint at the City of Philadelphia, and for other purposes." The section 2 of the act referred to reads as follows:

"*And be it further enacted*, That, for the purpose of securing a due conformity in weight of the coins of the United States . . . the brass troy-pound weight procured by the minister of the United States at London, in the year one thousand eight hundred and twenty-seven, for the use of the mint, and now in the custody of the Mint at Philadelphia, shall be the standard troy pound of the Mint of the United States, conformably to which the coinage thereof shall be regulated."

The troy pound thus adopted had been procured in the year 1827 by Albert Gallatin, minister of the United States at London, and brought to this country by special messenger,[9] who delivered it to the director of the Mint at Philadelphia. The weight was of brass and an exact copy of the imperial troy pound of Great Britain, according to the statement of Captain Kater, who made the comparison between the two standards. The casket and accompanying packages were retained under seal until Mr. Adams, President of the United States, visited Philadelphia and verified the seal of Mr. Gallatin and the other facts in regard to its authenticity.

This ceremony took place on October 12, 1827, and the full certificate of President Adams in regard to the seal, which he readily recognized, and to the whole transaction and consequent accuracy of the weight was added to the vouchers in the case. He declared, in conclusion, his belief that the brass weight then exhibited was the indentical pound copy of the imperial standard troy pound of Great Britain referred to in the aforesaid certificates.[9] The foregoing facts were communicated to Congress through the Committee on the Mint and resulted in the passage of the act cited above.

While the act of Congress of 1828 only made this pound the standard for coinage, it virtually became the fundamental standard of the United States from which the avoirdupois pound in common use was derived.

On May 29, 1830, two years after the mint pound had been legalized for coinage, the Senate passed a resolution directing the Secretary of the Treasury to cause a comparison of the weights and measures in use at the principal custom-houses to be made, and to report to the Senate at its next session.

Steps were promptly taken by the Treasury Department to comply with the resolution of the Senate, and the preliminary report of F. R. Hassler, Superintendent of the Coast Survey, to whom the investigation had been intrusted, was transmitted to the Senate on March 3, 1831,[10] this being followed by a more complete report in June, 1832.

As was anticipated, large discrepancies were found to exist among the weights and measures in use at the different ports, some being too small and others too large, but the average value of the various denominations agreed fairly well with the weights and measures in use in Great Britain at the time of the American Revolution.

Without waiting for authority from Congress the Treasury Department took immediate steps to correct the evil by having constructed, under the direction of Mr. Hassler, the necessary weights and measures for the customs service. The divergencies among the weights and measures in use in the customs service were directly opposed to the spirit of the Constitution, which requires that all duties, imposts, and excises shall be uniform throughout the United States,[11] and the Secretary of the Treasury felt fully authorized in taking steps to secure uniformity when discrepancies were once known to exist.

Before weights and measures could be constructed, however, it was necessary for the Treasury Department to determine upon certain units and to adopt material representatives of these units. Those finally adopted were the yard of 36 inches, the avoirdupois pound of 7,000 grains, the gallon of 231 cubic inches, and the bushel of 2,150.42 cubic inches. The standard yard adopted was the 36 inches comprised between the twenty-seventh and the sixty-third inches of a certain 82-inch brass bar, prepared for the Coast Survey by Troughton, of London. This bar had been brought to the United States by Hassler in 1813, and the 36-inch space referred to was supposed to be identical with the English standard at 62 degrees Fahr., though it had never been directly compared with that standard.

It is evident from the reports of Mr. Hassler that he regarded the English yard as the real standard of length of the United States and the Troughton scale merely as a copy whose length should be corrected if it was subsequently found to differ from the English yard; and this view was taken by those who subsequently had charge of our standards, as will be shown later on.

The avoirdupois pound adopted by Mr. Hassler as the standard for the Treasury Department was derived from the troy pound of the mint according to the equivalent, 1 avoirdupois pound equals $\frac{7000}{5760}$ pounds troy. This was the accepted relation in this country as well as in England; hence both the troy and avoirdupois pounds adopted were in practical accord with the similar standards of Great Britain.

CAPACITY STANDARDS.

The units of capacity, namely, the wine gallon of 231 cubic inches and the Winchester bushel of 2,150.42, were adopted, because, as intimated, they represented more closely than any other English standards the average of the capacity measures in use in the United States at the date of Mr. Hassler's investigation. The wine gallon was introduced as a wine measure into England in 1707, during the reign of Queen Anne, but it was abolished in 1824, when the new imperial gallon, containing 10 pounds of water, was made the standard. This last statement applies also to the bushel of 2,150.42 cubic inches. This bushel is the earliest English capacity measure of which we have any record, a copy of it made by order of Henry VII being still in existence. But this bushel

[9] Report on Weights and Measures, Franklin Institute, 1834, Appendix No. VII.

[10] See H. R. Doc. No. 299, 22d Cong., 1st sess.

[11] Sec. VIII, clause 1.

had also been abolished in England, it having been superseded by the bushel of 8 imperial gallons. Therefore neither the gallon nor the bushel adopted by the United States Treasury Department was in accord with the legal capacity standards of England, but they were smaller by about 17 per cent. and 3 per cent., respectively, and these differences exist at the present time. Not only did they differ from the new standards in Great Britain, but they also differed from the discarded English standards from which they were derived, for the reason that Mr. Hassler selected the temperature of the maximum density of water, namely, 39.2 degrees Fahr.[12] as the temperature at which the United States measures were standard, whereas their English prototypes were standard at 62 degrees Fahr.

Such, then, were the fundamental standards adopted upon the recommendation of Mr. Hassler by the United States Treasury Department, and to which the weights and measures for the customs service were made to conform. The construction of the weights and measures for this purpose was pushed with almost feverish haste, and so well satisfied was Congress with the progress made that the following resolution was passed and approved June 14, 1836:

"Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Treasury be, and he hereby is, directed to cause a complete set of all weights and measures adopted as standards and now either made or in progress of manufacture for the use of the several custom-houses, and for other purposes, to be delivered to the governor of each State in the Union, or such person as he may appoint for the use of the States, respectively, to the end that a uniform standard of weights and measures may be established throughout the United States."

While the act does not specifically adopt the standards above described, the practical effect of it was to make them the standards for the United States, inasmuch as the weights distributed to the States in accordance with the act were in almost every case adopted by the State legislatures soon after their receipt.

The act of 1836 was supplemented in 1838 by a joint resolution of Congress, which directed the Secretary of the Treasury to furnish balances to the States. By 1838 the weights for the States were reported finished, and during the following year the weights for the custom-houses were completed and delivered.[13]

By 1850 practically all the States admitted to the Union had been supplied with complete sets of weights and measures, and in addition sets were presented to England, France, Japan, and Siam. As new States were admitted they were also supplied with sets of standards, the last set being supplied to North Dakota in 1893.

In order to carry out the provisions of the acts of 1836 and 1838 the Office of Weights and Measures, under the direction of the superintendent of the Coast Survey, had been established, and all the standards adopted at the beginning of the work, and subsequently, were in charge of this office, with the exception of the troy pound of the mint, which has always remained at Philadelphia.

In October, 1834, the British imperial yard and troy pound made in 1758, of which the Troughton scale and the mint pound were supposed to be exact copies, were destroyed by the burning of the Houses of Parliament. When the new imperial standards to replace them were completed in 1855, two copies of the yard and one copy of the avoirdupois pound were presented to the United States, arriving in this country in 1856. One of these bars, namely, bronze yard No. 11, was very soon after compared with the Troughton scale, the result showing that the accepted 36 inches of the Troughton scale was 0.00087 inch longer than the British imperial yard.[14] The second bar received from England was subsequently compared with the Troughton scale and fully corroborated the result obtained from the comparison with bronze No. 11. The new yards, and especially bronze No. 11, were far superior to the Troughton scale as standards of length, and consequently they were accepted by the Office of Weights and Measures as the standards of the United States, and all comparisons were afterward referred to the imperial yard through these two standards. They were twice taken to England and recompared with the imperial yard, once in 1876 and again in 1888.

The avoirdupois pound presented with the two yards was also compared with the United States avoirdupois pound derived from the mint pound, the result showing a very satisfactory agreement. The advent of the new pound did not, therefore, disturb the position of the troy pound of the mint or of the avoirdupois pound derived from the mint pound.

METRIC SYSTEM.

The next and perhaps the most important legislation enacted by Congress was the act of 1866 legalizing the metric system of weights and measures in the United States. The act, which was passed July 28, 1866, reads as follows:

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after the passage of this act it shall be lawful throughout the United States of America to employ the weights and measures of the metric system, and no contract or dealing or pleading in any court shall be deemed invalid or liable to objection because the weights or measures expressed or referred to therein are weights or measures of the metric system.

"SEC. 2. *And be it further enacted,* That the tables in the schedule hereto annexed shall be recognized in the construction of contracts and in all legal proceedings as establishing in terms of the weights and measures now in use in the United States the equivalents of the weights and measures expressed therein in terms of the metric system; and said tables may be lawfully used for computing, determining and expressing in customary weights and measures the weights and measures of the metric system."

Metric Denominations and Values.		Equivalents in Denominations in Use.	
Myriameter.	10,000 meters	6.2137	miles
Kilometer,	1,000 meters	0.62137	miles, or 3,280 feet and 10 in.
Hectometer,	100 meters	328	feet and 1 in.
Dekameter,	10 meters	393.7	inches
Meter,	1 meter	39.37	inches
Decimeter,	$\frac{1}{10}$ of a meter	3.937	inches
Centimeter,	$\frac{1}{100}$ of a meter	0.3937	inch
Millimeter,	$\frac{1}{1000}$ of a meter	0.0394	inch

MEASURES OF LENGTH.

Metric Denominations and Values.		Equivalent in Denominations in Use
Hec are	10,000 square meters	2.471 acres
Are.....	100 square meters	119.6 square yds.
Centare..	1 square meter	1 550 square in.

MEASURES OF SURFACE.

While the above act was being considered, Congress also considered a resolution authorizing the Secretary of the Treasury to furnish the States with metric weights and measures. Strange to say, this resolution, which logically should follow, was approved one day before the act legalizing the use of the metric system. It was a joint resolution, and read as follows:

"Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Treasury be, and he is hereby, authorized and directed to furnish to each State, to be delivered to the governor thereof, one set of standard weights and measures of the metric system for the use of the States, respectively."

The work of making and adjusting these standards fell, naturally, upon the Office of Weights and Measures, and the first question that had to be considered was that of standards. The practice followed by other countries which had adopted the metric system, of accepting the meter and the kilogram of the archives of France as fundamental standards, was followed by the United States. The question was

[12] According to the determination made by Mr. Hassler on the expansion of water, 39.83 degrees Fahr. was the temperature of maximum density. See report of Alexander D. Bache, Superintendent of Weights and Measures, 46-47. Ex. Doc. No. 73, 30th Cong., 1st sess.

[13] H. R. Doc. 159, 28th Cong., 2d sess.

[14] See Report of the Secretary of the Treasury on the construction and distribution of weights and measures in 1857. S. Doc. No. 27, 34th Cong., 3d sess.

mainly one of securing authentic copies of these standards. Fortunately, the Office of Weights and Measures had several copies of both standards of more or less authenticity on hand, but without hesitation an iron bar, known as the "committee meter," and a platinum kilogram, known as the "Arago kilogram," were selected.

COMMITTEE METER.

The committee meter is one of fifteen similar bars, whose lengths were ascertained in the process of constructing the original meter by the French committee of weights and measures in 1799; hence its name, "committee meter."

The committee referred to was composed of members of the National Institute of France and of deputies from foreign countries. J. G. Tralle, the deputy from the Helvetic Republic, had been placed in charge of the construction of the meters, and when the bars were distributed among the members of the committee he secured two of them, one of which he presented to Mr. Hassler. This bar was therefore of the highest authenticity. As before stated, it is made of iron, with a cross-section of 9 by 29 mm., and its length is defined by the end surfaces, which are remarkably plane, when one considers the age in which the bars were made. The bar bears the stamp of the committee, namely, a small ellipse, whereof three quadrants are shaded and the fourth one clear, except for the number 10,000,000, which indicates the number of meters in a meridian quadrant of the earth. It also bears the mark :. at one end, by which it was distinguished during the comparison with the other meters. In Mr. Hassler's report on the construction of the meters[15] it is stated, on the authority of Mr. Tralle, that all the meters agreed with the true meter within one-millionth part of the toise.[16]

When Mr. Hassler came to the United States in 1805 he brought with him the committee meter, which he soon after presented to the Philosophical Society of Philadelphia, Pa. Shortly after, when he was put in charge of the survey of the coast, the meter was placed at his disposal by the Philosophical Society, and he made it the standard of length for that work, and until 1890 all base measurements of the survey were referred to this meter.[17]

In view of the foregoing, it was but natural that this bar should be selected as the standard to which the State meters should conform.

ARAGO PLATINUM KILOGRAM.

The Arago kilogram was procured in 1821 by Mr. Gallatin while minister of the United States to France, and was sent to this country, together with a platinum meter. The certificate of Arago, the celebrated physicist, which accompanied these standards, states that the kilogram differs from the original kilogram des Archives by less than 1 mg. The weight is a platinum cylinder with flat bases, the edges being slightly rounded. The height and diameter are nearly equal, being approximately 39.5 mm. each. There is no stamp or distinguishing mark of any kind, except near the center of one base there is a faint lathe or tool mark of circular form. The weight is contained in a square mahogany box, on the cover of which is a circular silver plate bearing the inscription: "Kilogramme comparé pour son Poids a l'Etalon Prototype des Archives de France, et verifié par M. Argo. Fortin fecit." No particulars of Arago's comparison with the kilogram des Archives were furnished, and consequently it is not known what means were used by him in making his comparison, nor whether he reduced his weighings to vacuo. It was not until 1879 that the Arago kilogram was compared with any other standards of recognized authority. It is true that it was compared between 1852 and 1873 with a couple of kilograms in the possession of the Office of Weights and Measures, but as both of these weights were of brass and of unknown density, no great reliance could be attached to the results. In 1879, however, it was taken to England and there compared with the British platinum kilogram in the custody of the Standards Office. This comparison indicated that the Arago kilogram was 4.25 mg. light; but this result could not be considered conclusive, on account of certain assumptions made in the reduction to vacuo and also in regard to the correction to the British kilogram.

In 1884 the weight was taken from the Standards Office in London, where it had been since 1879, to the International Bureau of Weights and Measures at Paris and there compared with two auxiliary kilograms whose values in terms of the kilogram of the Archives were known with the greatest accuracy. The results obtained from the comparison confirmed that previously obtained from the comparison with the British kilogram, the result giving

$$K_a = 1{,}000\ g. - 4.63\ mg.$$

As the weights supplied to the States were to be made of brass, it was more convenient to compare them with a brass standard, and in order to do this two secondary brass standards were carefully compared between the years 1873-1876 with the Arago kilogram and afterward used in all the work of adjustment and verification. One of the kilograms, known as the Silbermann kilogram, was presented to the United States by France in 1852, together with a number of other weights and measures. The other kilogram used was one made in the Office of Weights and Measures and was identical in form and material with the kilograms subsequently furnished to the States.

The unit of capacity in the metric system being defined as the volume of the mass of 1 kilogram of pure water at the temperature of maximum density, the most convenient way to adjust such measures, and in fact all capacity measures, is by weighing the water they contain. The only two material standards that need to be considered, therefore, in connection with the metric weights and measures furnished to the States in accordance with the act of 1866, are the committee

Metric Denominations and Values.			Equivalents in Denominations in Use.	
Names.	Number of Liters	Cubic Measure.	Dry Measure.	Liquid or Wine Measure.
Kiloliter or stere.	1,000	1 cubic meter	1.308 cubic yards	264.17 gallons
Hectoliter	100	$\frac{1}{10}$ of a cubic meter	2 bushels and 3.35 pecks	26.417 gallons
Dekaliter	10	10 cubic decimeters	9.08 quarts	2.6417 gallons
Liter	1	1 cubic decimeter	0.908 quart	1.0567 quarts
Deciliter	$\frac{1}{10}$	$\frac{1}{10}$ of a cubic decimeter	6.1022 cubic inches	0.845 gill
Centiliter	$\frac{1}{100}$	10 cubic centimeters	0.6102 cubic inch	0.338 fluid ounce
Milliliter	$\frac{1}{1000}$	1 cubic centimeter	0.061 cubic inch	0.27 fluid dram

MEASURES OF CAPACITY.

Metric Denominations and Values.			Equivalents in Denominations in Use.
Names.	Number of Grams.	Weight of what quantity of Water at Maximum Density.	Avoirdupois Weight.
Millier or tonneau	1,000,000	1 cubic meter	2,204.6 pounds
Quintal	100,000	1 hectoliter	220.46 pounds
Myriagram	10,000	10 liters	22.046 pounds
Kilogram or kilo	1,000	1 liter	2.2046 pounds
Hectogram	100	1 deciliter	3.5274 ounces
Dekagram	10	10 cubic centimeters	0.3527 ounce
Gram	1	1 cubic centimeter	15.432 grains
Decigram	$\frac{1}{10}$	$\frac{1}{10}$ of a cubic centimeter	1.5432 grains
Centigram	$\frac{1}{100}$	10 cubic millimeters	0.1543 grain
Milligram	$\frac{1}{1000}$	1 cubic millimeter	0.0154 grain

WEIGHTS.

[15] H. R. Doc. No. 299, 22d Cong., 1st sess., pp. 75, 76.

[16] The toise was the French standard of length prior to the adoption of the meter, and all the geodetic measurements upon which the meter was based were made with the toise. Its length is 1.949+ meters.

[17] Special Publication No. 4, U. S. Coast and Geodetic Survey.

meter and the Arago kilogram described above.

By the end of 1880 practically all the States had been supplied with sets of metric weights and measures consisting of the following denominations:

Length measures	1 brass-line meter. 1 steel-end meter.
Capacity measures	1 liter made of brass. 1 decaliter made of brass.
Weights	1 myriagram made of brass. 1 kilogram made of brass, 1 ½ kilogram made of brass. 1 gram made of brass. 1 set of small silver weights from 4 decigrams to 1 milligram.

It is necessary at this point to go back a few years and give an account of the establishment of the International Bureau of Weights and Measures, since the present fundamental standards of length and mass for practically the whole civilized world result from the establishment of that institution.

In response to an invitation of the French government, the following countries sent representatives to a conference held in Paris on August 8, 1870, to consider the advisability of constructing new metric standards: Austria, Ecuador, France, Great Britain, Greece, Italy, Norway, Peru, Portugal, Russia, Spain, Switzerland, Turkey, United States, Colombia; in all, fifteen countries. This conference was of short duration, on account of the war then raging between France and Germany.

A second conference was held two years later, at which thirty countries were represented, the United States again being among this number. At this conference it was decided that new meters and new kilograms should be constructed to conform with the original standards of the Archives, and a permanent committee was appointed to carry out this decision. The preparation of the new standards had advanced so far by 1875 that the permanent committee appointed by the conference of 1872 requested the French government to call a diplomatic conference at Paris to consider whether the means and appliances for the final verification of the new meters and kilograms should be provided, with a view to permanence, or whether the work should be regarded as a temporary operation.

In compliance with this request a conference was held in March, 1875, at which nineteen countries were represented, the United States as usual being of the number.

On May 20, 1875, seventeen of the nineteen countries represented signed a convention which provided for the establishment and maintenance of a permanent International Bureau of Weights and Measures to be situated near Paris, and to be under the control of an international committee elected by the conference, the committee to consist of fourteen members, all belonging to different countries.

In addition to the primary work of verifying the new metric standards the bureau was charged with certain duties, the following being the most important:

(1) The custody and preservation, when completed, of the international prototype and auxiliary instruments.

(2) The future periodic comparison of the several national standards with the international prototypes.

(3) The comparison of metric standards with standards of other countries.

The expenses of the bureau were to be defrayed by contributions of the contracting governments, the amount for each country depending upon the population and upon the extent that the metric system was in use in the particular country.

In accordance with the terms of the convention the French government set aside a plat of ground in the park of St. Cloud, just outside of Paris, and upon this ground, which was declared neutral territory, the International Bureau of Weights and Measures was established.

The construction of the meters and kilograms had been intrusted to a special committee, and early in 1887 the committee completed its work and the new meters and kilograms were turned over to the International Bureau for comparison with the standards of the Archives and with one another.

It had been decided as early as 1873 that the new standards should be made of an alloy of 90 per cent. platinum and 10 per cent. iridium, and that the meters should be line standards. Altogether 31 meters and 40 kilograms were constructed. By 1889 the entire work was completed and in September of that year a general conference was held in Paris, and by it the work of the international committee was approved.

The meter and kilogram which agreed most closely with the meter and kilogram of the Archives were declared to be the international meter and the international kilogram. These two standards, with certain other meters and kilograms, were deposited in a subterranean vault under one of the buildings of the International Bureau, where they are only accessible when three independent officials with different keys are present. The other standards were distributed by lot to the various governments contributing to the support of the International Bureau. Those falling to the United States were meters Nos. 21 and 27 and kilograms Nos. 4 and 20.

Meter No. 27 and kilogram No. 20 were brought under seal to this country by George Davidson, of the Coast and Geodetic Survey, and on January 2, 1890, they were opened at the White House and accepted by President Harrison, who certified that they were received in good condition, and that he confidently believed that they were the standards referred to in the report. The other two standards were received the following July and were deposited in the Office of Weights and Measures, where those accepted as national standards by the President had already been taken.[18] On April 5, 1893, the Superintendent of Weights and Measures, with the approval of the Secretary of the Treasury, decided that the international meter and kilogram would in the future be regarded as the fundamental standards of length and mass in the United States, both for metric and customary weights and measures.

This action did not in any way affect the metric weights and measures of the United States, inasmuch as the meter and kilogram of the Archives had always been regarded as our fundamental metric standards, and the international meter and kilogram had identical values so far as could be determined by the most refined measurements.

The effect of this decision on the customary weights and measures also left them practically undisturbed. All comparisons made immediately prior to 1893 indicated that the relation of the yard to the meter fixed by the act of 1866[19] was by chance the exact relation between the international meter and the British imperial yard within the error of observation. A subsequent comparison made between the standards just mentioned indicates that the legal relation adopted by Congress is in error by one ten-thousandth of an inch; but in view of the fact that certain comparisons made by the English Standards Office between the imperial yard and its authentic copies show variations as great, if not greater than this, it cannot be said with certainty that there is a difference between the imperial yard of Great Britain and the United States yard derived from the meter.

The case of the pound was slightly different, inasmuch as the relation of the kilogram to the pound, fixed by the act of 1866, was only approximate. In the act mentioned the kilogram was stated to be equal to 2.2046 pounds avoirdupois; but as 2.204622 was known to be a more precise value, and since it did not conflict with the legal value the avoirdupois pound was declared to be equal to $2.20\frac{1}{4622}$ kilogram.

Neither the troy pound of the mint nor the copies of the imperial yard in the possession of the Office of Weights and Measures were satisfactory standards. The mint pound is made in two pieces, the knob being screwed into the body; hence its density cannot be determined by weighing in water on account of danger of leakage. Moreover, it is made of brass not plated, and therefore liable to alteration by oxidation.

The bronze yard No. 11, which was an

[18] Upon the establishment of the Bureau of Standards on July 1, 1901, all standards and other property in possession of the Office of Weights and Measures passed under the control of the Bureau.

[19] The value of the yard, in accordance with the above declaration, is 1 yard = 3600-3937 meter.

exact copy of the British imperial yard both in form and material, had shown changes when compared with the imperial yard in 1876 and 1888 which could not reasonably be said to be entirely due to changes in No. 11. Suspicion as to the constancy of the length of the British standard was therefore aroused.

On the other hand, the new meters and kilograms represented the most advanced ideas of standards, and it therefore seemed that greater stability in our weights and measures, as well as higher accuracy, would be secured by accepting the international meter and kilogram as fundamental standards.

Time has amply proved the wisdom of this action, and therefore when the Bureau of Standards was established, in July, 1901, the decision made by the Office of Weights and Measures in 1893 to adopt the meter and kilogram as fundamental standards was fully accepted by this Bureau.

In conclusion I wish to state that in preparing so brief an account of so great a subject many matters of importance and interest have necessarily been omitted but if I have succeeded in giving you an outline of the growth of our weights and measures, I shall have accomplished all that I had in mind when this paper was prepared.

If the General Electric Company completes its contract on time, persons traveling from Philadelphia to Atlantic City during the latter part of next summer will no longer have the opportunity of contrasting the smoke and cinders of the Pennsylvania route with the clearer atmosphere of its anthracite-burning rival, since the Pennsylvania's line from Camden is to be operated by electricity, thus doing away altogether with locomotives. The multiple-unit system will be employed, each motor-car having two 200 horse-power motors. The third rail will be used over the greater part of the route, the current being direct, with an electromotive force of 650 volts. The current will be supplied by turbo-generators at Camden, the power being transmitted to the sub-stations as three-phase alternating current at 33,000 volts.

A Drawing Record and Indexing System.

BY L. F. B.

I have read many articles on drawing-room practice in the columns of the AMERICAN MACHINIST and have tried many of the ideas therein given which, when put to practice, have proved so satisfactory that now many of them seem indispensable. I have been prompted to describe the following indexing system and drawing record and hope it will prove as helpful to others as some of their ideas have been to me.

For a long time we had trouble in filling orders for repairs, as no accurate detailed record had been kept of the various changes in the product, which, by the way, is machine tools. Even though the number of the machine and description of the piece were given in the repair order, frequent mistakes occurred through sending a piece which, often on account of a slight change not recorded, would not interchange with the piece which it was to replace. Sometimes it varied only a few thousandths of an inch, yet caused delay and expense annoying to both parties involved. This system of records was made principally to overcome these mistakes and incidentally has been a source of satisfaction to all those around the plant who have to handle the drawings. It is not wholly original with me, but is the result of the combined efforts and suggestions of all those about the shop who were directly interested.

Record of each separate piece of a machine is made and kept in a book which is ruled and numbered consecutively, as shown in Fig. 1. A new piece just drawn —the headstock base, for instance—is numbered 61480 and marked so on the drawing because that is the next unused number in the book. It is used on a No. 6 universal machine and is detailed on drawing 5323-B and tracing 5323-A. It supersedes No. 60286 on drawing 5289 and is in turn superseded by 61512 on drawing 5360, as shown in the record. This gives a complete history of the piece, where it came from and what takes its place. The slightest change in a piece changes its number, unless the new and old pieces are absolutely interchangeable. It has been argued that any change whatsoever should change the number whether they are interchangeable or not, as there is danger of some point being overlooked and numbers will not give out. However, at present we change the number only when the new piece will not replace the old on the old machine. The letters A and B following the drawing numbers have reference only to the size. Our drawings are in three sizes, the border line dimensions being 12x18, 18x24 and 24x36 inches. The letter A refers to the largest, B to the medium, and C to the smallest.

When the original design of a machine or part of a machine is pronounced correct, the drawing becomes permanent and is numbered with the next consecutive number in the card index and a record is made on the card, as shown in Fig. 2. Each drawing has a card of this style, showing the number of the drawing it supersedes and the drawing by which it is superseded. The date of the mounted print is marked in pencil, so that if at any time a print is renewed the date is easily changed. The individual machine numbers are given from 1150 to 1200, hence all the machines having these numbers are

No.	Title	Machine	Drawing	Tracing	Supersedes No.	Supersedes Dr.	Superseded By No.	Superseded By Dr.
61480	Headstock Base	#6-U	5323-B	5323-A	60286	5289	61512	5360
61481	" Clamping Lever	" "	"	"	60287	"	61513	"
61482	" Drive Pulley	" "	"	"	60288	"	61514	"
61483	Cross Slide	" "	5324-B	5324-B	60291	5291	61510	5357
61484	" " Gib	" "	"	"	60292	"		
61485	Face Plate	" "	5325-C	5325-C				
61486	" " Bushing	" "	"	"				

American Machinist

FIG. 1. A SAMPLE RECORD PAGE.

Dr. 4629-A	Head Stock-Assembled		
Changed From	Tracing	Mounted Prints	Changed To
4330 B	4629-A	Sept. 5, 1902.	4717 A
#6 Universal	Machines Nos. 1150 to 1200 Inclusive		
Details-Cone Pulley & Gearing-Dr. 5301-C			
" -Spindle-Dr. #5321-C			
" -Base - " #5323-B			

FIG. 2

Head Stock

Mach.	Piece No.		Tracing Drawer	Drawing No.	Drawer
#6-U		Assembled	7	4629	3
"	25460	Spindle	7	5321	3
"	61480	Base	7	5323	4

American Machinist

FIG. 3

THE CARDS

just as the drawing shows. If the drawing is obsolete, as in this case, being superseded by No. 4717-A, the number is crossed out with red ink, so as to show at a glance that it is out of date and yet allow the number to be easily discernable. Any notes pertaining to the drawing are inserted in the lines below. Cards like Fig. 2 run consecutively in the case, needing no other index.

The card in Fig. 3 has an alphabetical index, so that the head can be found quickly. The two indexes give a quick reference to either title or number. Those on the card in Fig. 3 that are obsolete are marked with a red O. All our drawings are kept in vaults in suitable size drawers and the drawings run consecutively, starting with the lowest number at the floor and running to the highest at the top of the case. The numbers of the drawers are also given on the card, Fig. 3. Tracings and drawings are of course kept separately, the drawings at one side of the vault and the tracings directly opposite, so that the tracing can be found very quickly if the location of the drawing is known.

After all details are made from an assembly drawing, all parts are numbered on the tracing of this drawing and a detail list put in the corner, thus:

Detail No. 25460 on Dr. No. 5321
" 61480 " 5323

and so on with every piece shown. The shop foreman can then look over the assembly blueprint and pick out all the pieces to be machined, thus getting the drawing numbers without loss of time. This feature has received the highest commendation from the shop.

We have found the system to be very satisfactory, and any piece ordered can be delivered correctly if the number of the machine is known. It looks like a good deal of red tape at first glance, but it has not seemed so in practice. After finishing each drawing or tracing, it takes very little time to make the short record required. Each draftsman has a supply of both kinds of cards at his desk, and only in detailing is it necessary to go for the book. The entire record is kept with a book and a two-section card-index system. However, we feel that it is not perfect and that it could be greatly improved upon, yet its convenience certainly justifies its continued use until we learn of something better, for the results we get from it are better than those secured with anything else we have as yet used.

John Burns, the English labor leader, whose course has been such as to command the respect of all fair-minded men whether friends or foes and who has been recently made the first of labor men to be a member of the British Cabinet, started in life by serving an apprenticeship in an engineering works, and was employed by R. Hoe & Co., in London, when elected a member of the London County Council.

The Design of a Combined Punching and Shearing Machine.

BY OBSERVER.

SPECIFICATION.

The machine is to be capable of shearing 1-inch thick plates through a length of 10 inches at each cut, to be able to punch a 1⅛-inch diameter hole through ¾-inch thick plates and to make 12 strokes per minute.

The frame is to be of the best gray iron; the crankshaft, the intermediate shaft and main spindle of the best mild steel; the bushes for the crank and intermediate shafts of gun metal; the bushes for the main spindle of phosphor bronze; the gears of the best gray iron; the shearing and punching slides and the shearing block of the closest-grained gray iron; the punching block of gray wrought steel; and the shear blades and punches of the best steel procurable.

CALCULATIONS FOR SIZE OF PIN.

Taking the total resistance as 150,500 pounds, which allows 500 pounds to overcome the friction of the machine, and also allowing 12,000 pounds per square inch for safe working stress of steel, we have

$$\frac{\pi}{4} d^2 f_s = 150{,}500$$

$$\therefore d^2 = \frac{150{,}500 \times 4 \times 7}{12{,}000 \times 22}$$

$$\therefore d = \sqrt{\frac{150{,}500 \times 4 \times 7}{12{,}000 \times 22}}$$

$$= \sqrt{15} = 3\tfrac{7}{8} \text{ inches dia. of pin.}$$

The greatest thickness of work = 1 inch, for which the stroke would be, say 1½ inch. Diameter of eccentric pin + stroke = main shaft diameter, or 3¾ + 1½ = 5¼ inches.

Gears.—The gears are of the following dimensions:

Wheel A = 16 teeth 1¾ inch pitch, diameter of P. C. = 8 1/16 inches, 1 foot 3 1/16 inch centers.

Wheel B = 40 teeth 1¾ inch pitch, diameter of P. C. = 1 foot 10¼ inches, 1 foot 3 1/16 inch centers.

Wheel C = 15 teeth 2 inch pitch, diameter of P. C. = 9 9/16 inches, 2 feet 4 1/32 inch centers.

Wheel D = 75 teeth 2 inch pitch, diameter of P. C. = 3 feet 11¾ inches, 2 feet 4 1/32 inch centers.

The numbers of teeth give a ratio of 12.5 to 1, so that the engine running at 150 revolutions per minute gives to slide 12 strokes per minute.

Assuming the maximum resistance of punch and shear to be 150,000 pounds, we have

$$\frac{\text{Total resistance} \times \text{stroke}}{\text{Radius of wheel } D \times 2} = \frac{150{,}000 \times 1\tfrac{1}{2}}{23\tfrac{7}{8} \times 2}$$

$$= \frac{150{,}000 \times 3 \times 8}{191 \times 2 \times 2}$$

$$= \frac{900{,}000}{191} = 4{,}712 \text{ pounds} = \text{force applied}$$

at the circumference of large wheel.

To find breadth, assuming pitch to be 2 inches, let

t = thickness of one tooth,
h = height,
$n P = \frac{2}{3} P$ where $P = 4{,}712$ pounds,
$f_s = 8{,}000$ pounds per square inch,

then maximum bending moment = moment of resistance, or

$$\tfrac{2}{3} \text{ pressure} \times .66 \text{ pitch} = \tfrac{1}{6} b h^2 f_s$$

$$\frac{2 \times 4{,}712}{3} \times .66 \times 2 = \tfrac{1}{6} b \times 1 \times 1 \times 8{,}000$$

$$\therefore b = \frac{2 \times 4{,}712 \times .66 \times 2 \times 6}{3 \times 1 \times 1 \times 8{,}000}$$

$$= \frac{3{,}109.92}{1{,}000} = 3.109 \text{ inches, breadth of tooth}$$

theoretically, say 5 inches wide, allowing ample margin for shocks, etc.

TO FIND SIZE OF ARMS FOR LARGE WHEEL.

If

V = number of arms (say 6),
P = total pressure,
R = radius of wheel,
F = 4,200 pounds per square inch,

then using the notation of Fig. 3,

$$2ah^2 = \frac{6PR}{FV}$$

$$= 2 \times 1 \times h^2$$

$$= \frac{6 \times 4{,}712 \times 23\tfrac{7}{8}}{4{,}200 \times 6}$$

$$\therefore h = \sqrt{\frac{6 \times 4{,}712 \times 191}{4{,}200 \times 6 \times 2 \times 8}}$$

$$= \sqrt{14} = 3\tfrac{3}{4},$$

say 4½ inches, allowing for shocks, etc.

The wheel A is keyed to the crankshaft by a ¾x9-16-inch key, let ¼ inch into the shaft and 5-16 inch in the wheel. The wheels B and C are keyed to the intermediate shaft by a ⅞-inch wide by ⅝-inch thick key, let 5-16 inch in the shaft and 5-16 inch in the wheel. The wheel D is keyed to the main shaft by a 1¾-inch wide by 1¼-inch thick key, let ⅝ inch in the shaft and ⅝ inch in the wheel.

The shearing motion consists of a slide-block which is held in the frame by projecting lips from the body on the sides, and held in front by means of a plate. The block is moved up and down by means of a gray-iron tumbler, which is bored to receive the eccentric pin of the main shaft. The tumbler is bedded at the bottom to the side-block; the tumbler oscillates on this bearing, the distance the pin carries it, thus changing the motion from circular to linear. The shear blades are of best steel and are fastened to the slide (top slide) and to the body (bottom blade) by means of two ⅞-inch diameter bolts in each blade. The slide and body are each planed out to receive the blades, so that no stress is put on the bolts when the shear is in operation. The pin is lubricated by means of a pipe and well carried in the slide, the sides, back and front on slide being grooved for the oil to be distributed about. Over the oil well is fitted a wood or gray-iron cover to prevent the dirt or dust getting into the oil.

The punching motion consists of a slide-

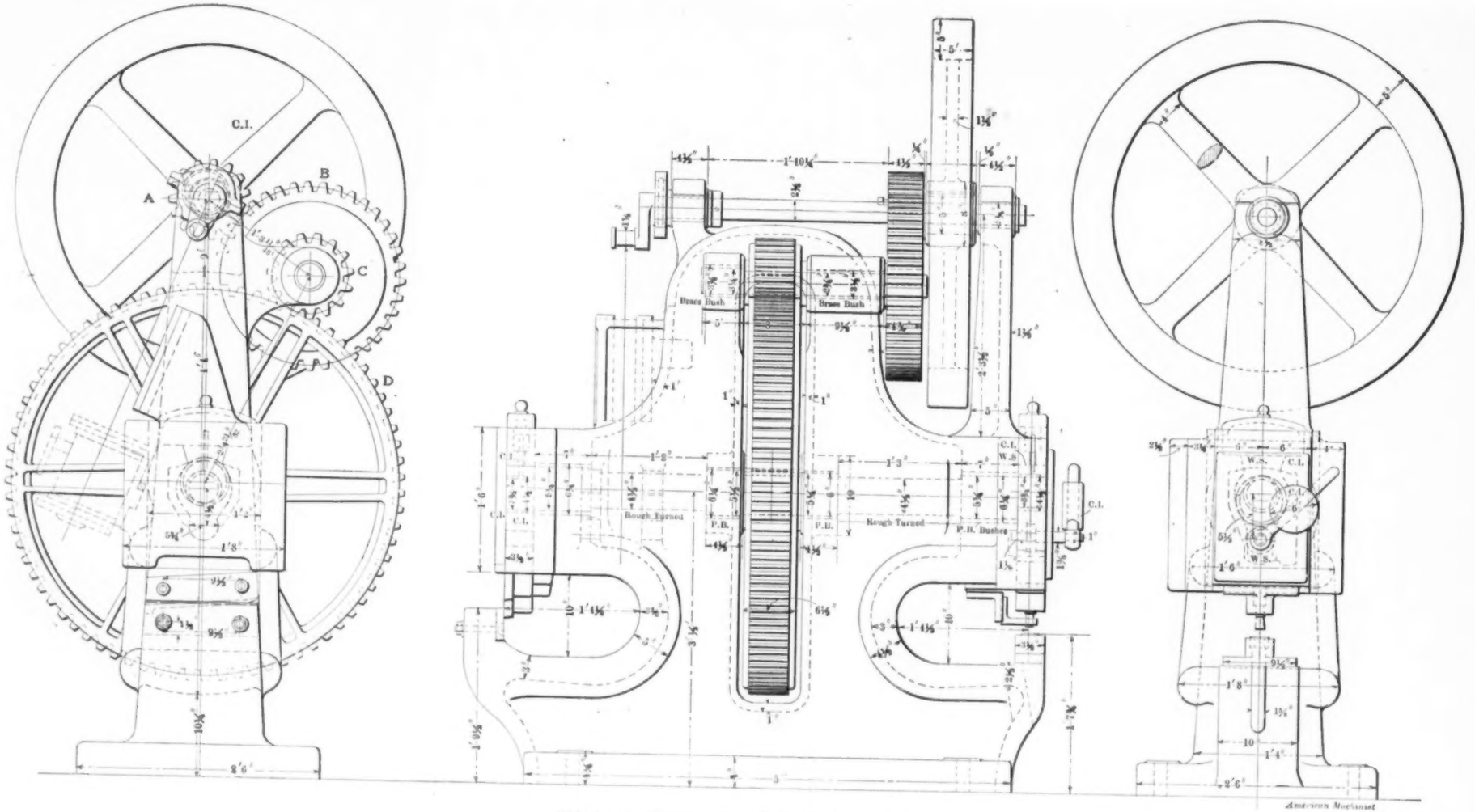


FIG. I. PUNCHING AND SHEARING MACHINE.

block, which is held to the frame by V-shaped sides and strips. The strip is held in position by means of three 1-inch diameter strip screws and set up when wear takes place by two 1-inch diameter set-screws. The block is moved up and down by means of a wrought-steel tumbler which is bored to receive the eccentric pin of the main shaft. The lower part of the tumbler is slotted out to receive the swivel-block, which is also made of wrought steel. The punch fits into a wrought-iron socket, which is fastened to the slide by means of stud bolts. The swivel-block is thrown in and out of gear by means of a shaft, lever and weight. The swivel-block is keyed to the shaft, and the shaft has its bearings in the slide-block. The weight on the lever is to keep the swivel-block out of gear when lever is thrown over. When the swivel-block is out it allows the slide-block to move up and down without the punch doing any work. There is also a guard which consists of two angle irons, one sliding on the other, which can be adjusted by means of a set-bolt to suit the varying thicknesses of plate required to be punched, the top angle iron being fastened to the body by means of a ¾-inch diameter screw and two steady pins. The guard is to prevent the work from rising when punch is on its return stroke.

Crankshaft bearings are 2½ inches diameter by 4½ inches long. The bearings are part of the frame, and are cored out

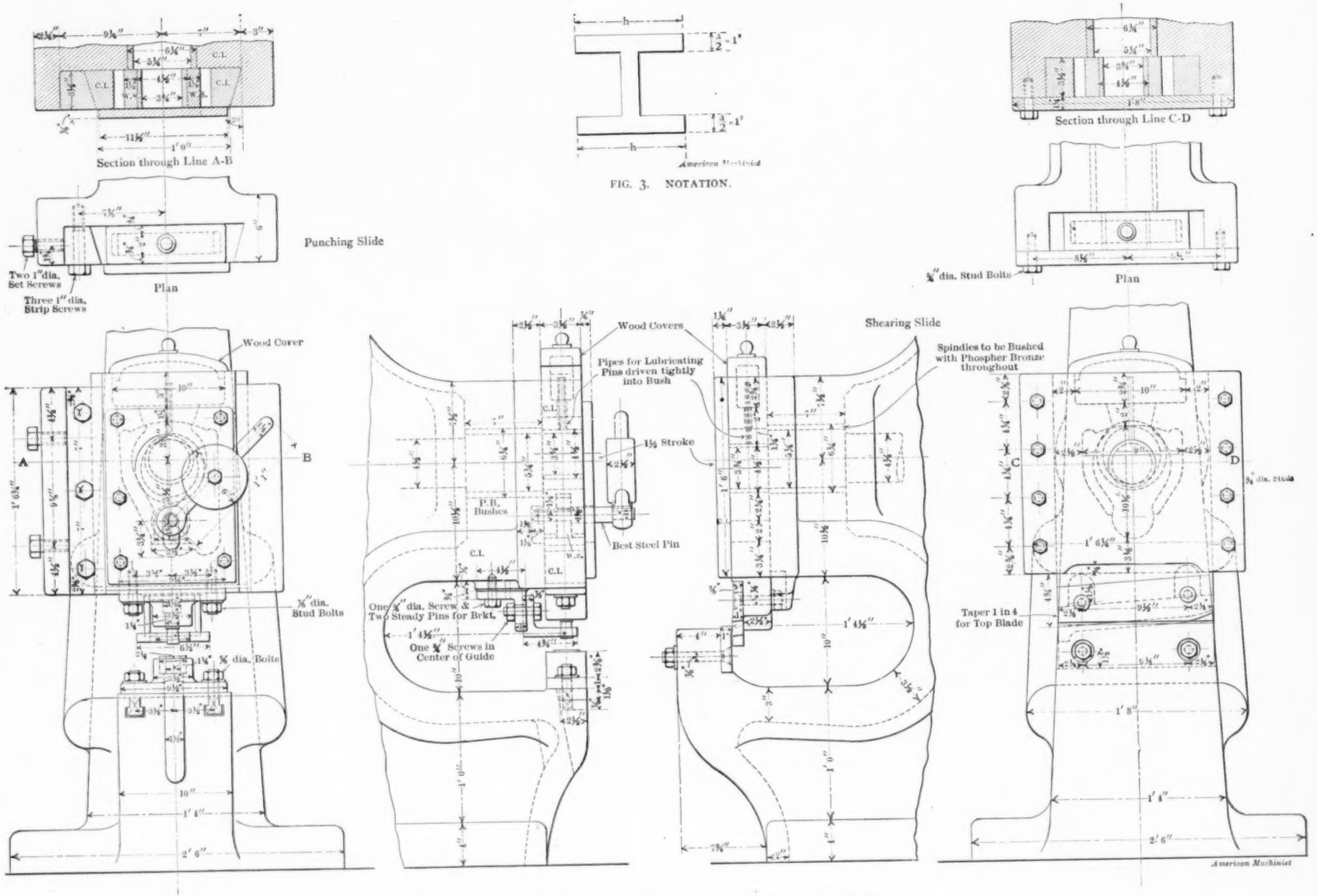


FIG. 3. NOTATION.

FIG. 2. ENLARGED DETAILS OF PUNCHING AND SHEARING MACHINE.

to receive the bolts, which are tee-headed. The bearings and caps are slotted down the sides and put together with the tee-bolts and then bored and faced down the sides to receive the bushes, which are of gun metal. The bushes are machined all over and are in halves across the center and have pegs let in top and bottom to prevent rotation. The caps are ¼ inch clear of the bearings, so that when the bushes wear they can be taken out, chippings taken off the faces and the cap tightened down. The caps are provided with an oil box, which lubricates the bearings by means of a wick, which is inserted down the center holes. The bushes are grooved inside to allow the oil to spread evenly over the bearing.

The main frame has been kept as straight as possible for ease and minimum cost in the patternmaking, and has about the same thickness of metal, so that in casting there will be little danger of strains setting up, due to uneven cooling of the metal. Seatings have been provided for the engine.

The punch and shear slides have been shown in their relative position to one another, so that when the shear goes down the punch leaves its work.

Victor Metal.

A white metal has been on the market for some time under this name. It is used for sand casting and is excellent for marine work, as it withstands the action of sea-water as well as any of the zinc alloys. It has a whiter color than german silver. The following analysis was made of a sand casting of this metal.

Copper	49.94 per cent
Zinc	34.27 per cent.
Nickel	15.40 per cent.
Aluminum	.11 per cent.
Iron	.28 per cent.

The iron is present as an impurity. It will be seen that the alloy contains a large amount of zinc. This renders the mixture cheap. As so much zinc is present, the alloy is hard, although quite strong. Great care must be used in making the mixture not to exceed the percentage of aluminum which is given, or brittleness will result. Two ounces of aluminum to 100 pounds of metal are all that are necessary. If one desires to duplicate the mixture, the following may be taken:

Copper	50 pounds.
Zinc	35 pounds.
Nickel	15 pounds.
Aluminum	2 ounces.

The nickel and copper are melted together under borax and then the aluminum added. The zinc is next added. The metal is poured into ingots and gives better results after having been melted once. This mixture is too hard for rolling into sheet.—*The Brass World.*

Note on the Summation of Stresses in Certain Structures.*

BY CARL HERING.

At a recent meeting of this club a question arose incidentally concerning the variations in stress in a member of a mechanical structure under certain conditions. The animated discussion to which it gave rise showed that opinions differed quite decidedly and were firmly held. As the case is one which occurs frequently in practice, and as incorrect and incomplete solutions are published in some text-books and appear to be used not infrequently in practice, the writer thought the matter to be of sufficient importance to warrant making a complete analytical investigation of it.

The problem, which occurs in practice in many different forms, may be represented in its simplest form by the following illustration. Let *A* and *A*, Fig. 1, be two tension members held together by a bolt, *B*, which is put under permanent initial tension by having its nut screwed down tightly. If under these circumstances a tension is applied to the member *A A* as a whole, the question is: *is this tension added to that already existing in the bolt?* In other words, must the bolt be made strong enough to withstand the *sum* of the two strains? The bolts securing the cylinder head of a steam engine, or the bands around a wooden stave pipe for high water pressure, are fair illustrations of this problem occurring in practice.

One of the reasons why differences of opinion are held is that this apparently simple question does not admit of being answered by a mere yes or no; it depends on the conditions, as will be seen in the solution given below.

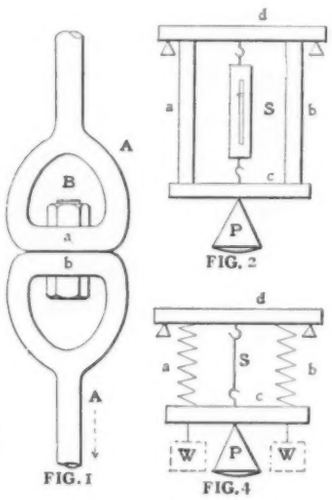
Some twenty-five years ago, when this same question arose, the writer made the following simple experiment: Referring to Fig. 2, *a*, *b*, *c* and *d* are four blocks of wood held together by an ordinary spring scale *S*, under tension, as shown. A scale pan *P* was attached to the lower block, and the whole system was suspended as shown.

In this apparatus the scale *S* represents the member under tension, and corresponds to the bolt *B* in Fig. 1. The members *a* and *b* are the members under compression, and correspond to the parts *a* and *b* in Fig. 1, which are compressed by the bolt. Weights placed in the scale pan *P* represent the additional and variable strains or loads applied externally to the system as a whole.

The initial tension on the tension member *S* was adjusted to be 10 pounds, as shown by the reading of the scale; hence the compression of members *a* and *b* was also 10 pounds. Weights were then placed in the scale pan *P*, one pound at a time, and it was found that for all weights less than the initial strain of 10 pounds the reading of the scale remained constant—namely, 10 pounds. This showed conclusively that under these conditions the externally applied strain was *not* added to the initial strain on the tension member, contrary to what is often claimed. The effect of the weights in the scale pan was *to diminish the compression* on the members *a* and *b*, and not to add tension to the other. With 10 pounds in the scale pan, the compressive strain on *a* and *b* was released entirely, and these members could then be withdrawn without changing anything in the system.

When the weights in the scale pan were in *excess* of the initial stress of 10 pounds, the stress on the tension member *S*, of course increased by exactly the same amount. But this is of less interest, as it would in most cases be beyond the range occurring in practice, because it means a leakage in such cases as cylinder heads, wooden stave pipes, etc., mentioned above.

This experiment therefore clearly proved beyond question that, *under those condi-*



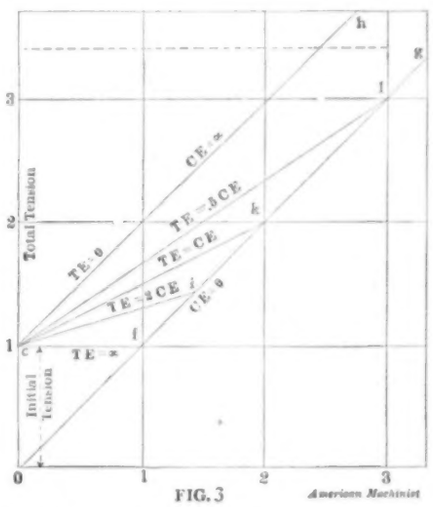


FIG. 3

COMBINED INITIAL AND LOAD TENSIONS ON BOLTS.

*A paper read before the Engineers' Club of Philadelphia.

tions and up to that limit, the member under tension will not be subjected to a greater tension by external forces than the original tension applied to it by screwing down the nuts sufficiently to prevent leakage.

During the above-mentioned discussion at this club, it was stated that the elasticity of the members under tension and compression would modify the result. The writer therefore extended this investigation to include the effects of these elasticities, and has found the following results, which seem to form a complete solution of the problem.

It was found by this investigation that the elasticities affected the results very greatly, and that the final strain on the tension member varied greatly with the *relative* elasticities of tension and compression of the two members.

The curves of results are *broken lines*, and therefore a graphical representation is preferable to an algebraic one, besides being more comprehensive and less liable to mislead. They are shown in Fig. 3 for the two extreme, limiting cases and for three intermediate values.

The first limiting case is when the elasticity of the compressive member is supposed to be zero and that of the tension member is infinity, or, in practice, when the elasticity of tension is very great as compared with that of compression; a flywheel whose spokes are under initial tension due to shrinkage might belong to this class. This is the case shown in Fig. 2, and has already been discussed; the spring scale was very elastic and the blocks quite inelastic. The beams *c* and *d* are, for simplicity, considered to be inelastic and therefore eliminated, as in most problems they do not exist and when they do their elasticity may be considered together with that of one of the essential members.

The curve for this case is the broken line *e-f-g* in Fig. 3. In this curve sheet the vertical distances represent the total tensile strains on the tension member The horizontal distances represent the *externally* applied tensile strains or loads, such as the steam pressure in a steam cylinder, or the water pressure in a wooden stave pipe. The initial tensile strain —that is, when there is no external strain —is shown by the horizontal line *e-f*, and, to make the solution a general one, this strain is here represented by unity.

From this broken line *e-f-g* it will be seen that, as external loads are added, the tensile strain remains constant—that is, the line is horizontal—up to a point, *f*, when the external strain is equal to the initial; after that, the tensile strain increases pound for pound with the external load, and is always equal to it, as has already been shown in connection with Fig. 2.

In practice this case arises when the tension member has a small cross-section and is relatively long and elastic, and when the reverse is the case with the compression member.

In the other extreme limiting case the elasticity of compression is supposed to be infinite and the elasticity of tension zero, or, in practice, the elasticity of tension is very small as compared with that of compression, as, for instance, when an elastic gasket is used under a cylinder head. This case is represented by the line *e-h*. In this case the total tensile strain increases pound for pound, with the external strain, from the start, and it is always equal to the *sum* of the external and the initial strains.

Such a case might be represented by Fig. 4, in which the members under compression, *a* and *b*, are shown as extremely elastic springs, while the tension member is a relatively inelastic wire, *S*. In such a case the springs may be considered as the equivalents of permanent weights *W*, shown in dotted lines, because the force with which they act on the beam *C* is always constant even for a slight elongation of the wire *S*. When thus replaced by weights it becomes self-evident that the strain on *S* must always be equal to the sum of the initial strains $W + W$, and the additional weights *P*. In practice this case arises when the tension member has a large cross-section and is relatively short and inelastic, and when the reverse is the case with the compression member. Perhaps wooden stave pipes would come under this case, as the wet wood which is under compression is very elastic relatively to the thick steel bands.

The results under all other conditions must, of course, lie between these two limits, represented by the curves *e-f-g* and *e-h*. They are all broken lines extending from the point *e* to the line *f-g* and then coinciding with the latter. They are here drawn for three intermediate cases, thereby clearly showing the law which governs all cases and enabling correct calculations to be made when the relative elasticities are known.

When, for instance, the elasticity of the tension member is double that of the one under compression, *e-i-g* will be the curve; it shows that one-third of the externally applied load must then be added to the initial strain of the tension member, up to the point *i*, at which the external strain is one and a half times the initial, after which the total tensile strain increases as the external load does, and is equal to the latter.

When the elasticity of the tension member is equal to that of the compression member, the curve is *e-k-g*, which shows that half of the externally applied load must always be added to the initial strain of the tension member. The turning point *k* is reached when the external load equals twice the initial strain.

Lastly, when the elasticity of the tension member is half that of the compression member, *e-l-g* is the curve; two-thirds of the external load must then be added to the initial strain. The turning point *i* then occurs at three times the initial strain.

It should be clearly understood that by the elasticity is here meant the *actual* elasticity of the member under strain; that is, the actual amount of the elongation or compression when under the particular stress, and not the coefficient of elasticity per unit cross-section and length. A member made of a very elastic material might be so large, or the force acting on it so small, that the actual change of dimension is still very small.

Referring again to Fig. 3, it will be noticed that the points at which leakage would occur in a case like a cylinder head or wooden stave pipe, are the turning points *f, i, k, l*, etc., all of which are on the 45-degree line. This point is therefore the more remote the greater the compression elasticity and the less the tension elasticity, which is self-evident. The line representing the point of rupture would in this diagram be a horizontal line in the upper part of it, as indicated by the dotted line. This shows that, within the leakage points, the point of rupture is the more remote the less the compression elasticity and the greater the tension elasticity; or in other words, exactly the reverse conditions as those for the point of leakage.

Green Patina Upon Brass.

An excellent dark-green patina may be obtained upon cast or rolled brass in the following manner, says *The Brass World*.

Dissolve 1 ounce of copper wire in 4 ounces of strong nitric acid. When all the copper has dissolved, add 20 ounces of acetic acid, ½ ounce of sal-ammoniac, and 1 ounce of strong muriatic acid.

The brass to be treated with this solution is cleaned and dipped, preferably with a matt dip, and, after rinsing, the foregoing solution is applied to it by means of a cotton swab or by dipping the article in it. It is imperative that the brass should be clean.

Within a short time the brass begins to turn a dark, olive green. The excess of liquid should not be wiped off, but must be allowed to remain on the surface. The article is allowed to remain for 24 hours and is then dried in an oven at a gentle heat. The article will then be covered with a dark-green oxidation or "patina" which gives it an antique appearance, but not the corroded appearance of verde-antique.

The best results are obtained when the article has been sand-blasted, as the rough surface which is so produced is attacked by the solution better than a smooth surface.

United States Consul Mowrer, of Ghent, Belgium, reports that in that country American motor boats are especially popular, and are often preferred to those made in any other country.

Universal Drilling Jig.

We had some very awkward little things to drill, the shape and size making them very tricky to hold and to drill cheaply. This led me to design the jig shown in Fig. 1, the idea of which is that it shall be suitable for more than one job. Most jigs are suitable only for the job for which they are made, and if that job has to be altered or is discarded, as is often the case in the cycle trade, where alteration in design is an annual thing, the jig has to be discarded with the job. This is where the jig shown scores, as with it only two small bushes, as shown alongside of the jig in Fig. 1, must be discarded for each job.

To adapt the jig to piece *A*, Fig. 5, a bottom bush is made with a half-round groove filed or milled across the center, which locates the article sideways. The top bush has a V-shaped groove at right angles to, and milled away to enter the bottom groove, thus leaving two little lugs or teeth, at equal distances from the center of the bush, which locate the piece endways. The piece is put in the bottom bush somewhere near the center of the groove, the top bush is brought down by pulling down the handle, and the V-shaped top lugs pull it central. While the left hand holds down the handle the right hand pulls down the drill handle. The suds being pumped on the top bush, the hole is drilled, the handle raised, the piece pushed out to the back, and another is slipped in, and so on. In Fig. 2 the jig is fixed on the platen of a sensitive drill with the bushes fitted for this particular job.

In the case of *B*, Fig. 5, the bottom bush has a V-groove across the center, which locates the piece sideways, the top bush having a V at a right angle to the bottom bush, which locates the piece endways, thus holding the piece central while the drill is brought down through the top bush, which fits the drill to prevent its running off the round top of the piece. In the case of *C*, Fig. 5, the top and bottom bushes are both alike, *i. e.*, cup-shaped. The ball is dropped into the bottom cup, and the top one is pulled down on it.

When a fresh job comes along it is only necessary to make two bushes, the top one with the hole to fit the drill, and the bottom one with a hole a little larger to clear the drill easily.

In Fig. 3 is shown a small platen which

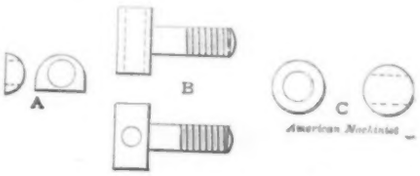


FIG. 5. WORK OF THE JIG.

is fitted to the jig for drilling holes at right angles or at a given distance from one another. The number of little attachments that can be fitted on this platen for different jobs is innumerable. In Fig. 4 a hole is being drilled at right angles to the one on the peg and a given distance from it. If a peg were fixed directly in the platen, a hole would be drilled parallel with the one on the peg and a given distance from it. I have also a socket for the stem of the same or another platen at the back for use should occasion arise.

It will be seen that the four joints are covered, and are thus kept clear of suds, drillings, etc. The outside all slopes to

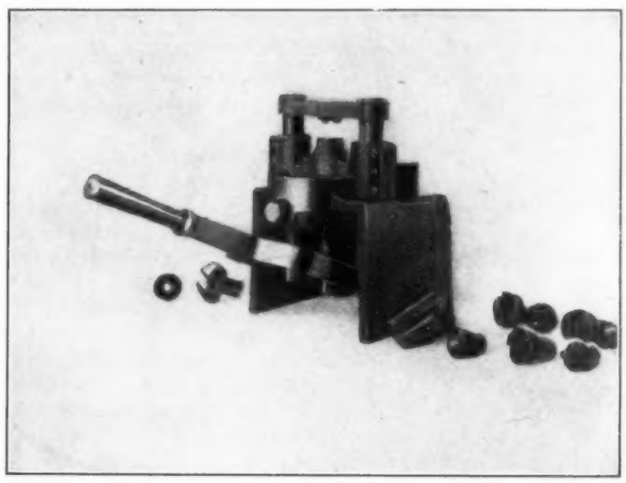


FIG 1.

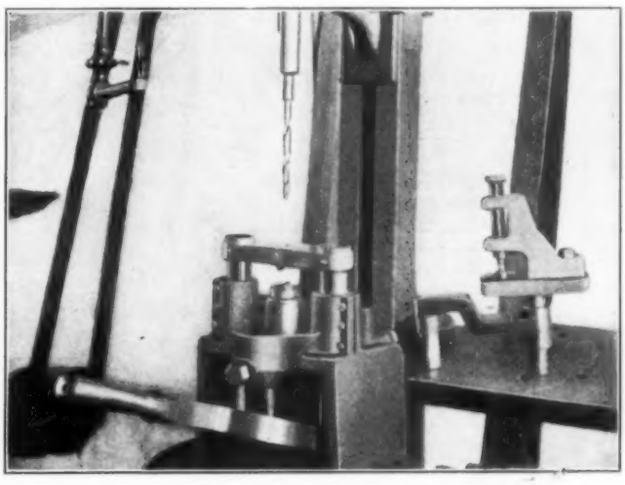


FIG. 2.

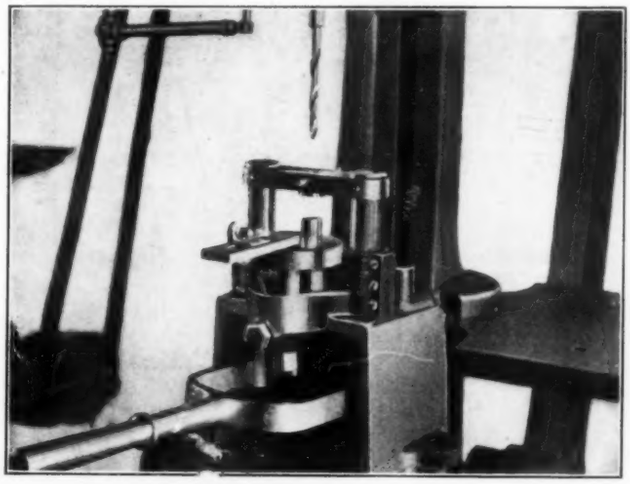


FIG. 3.

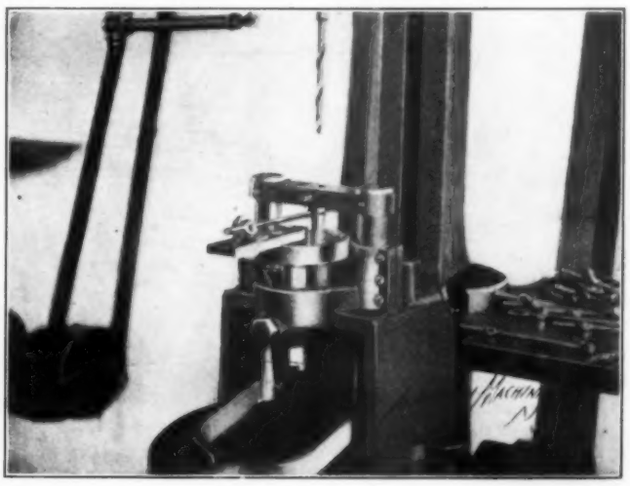


FIG. 4.

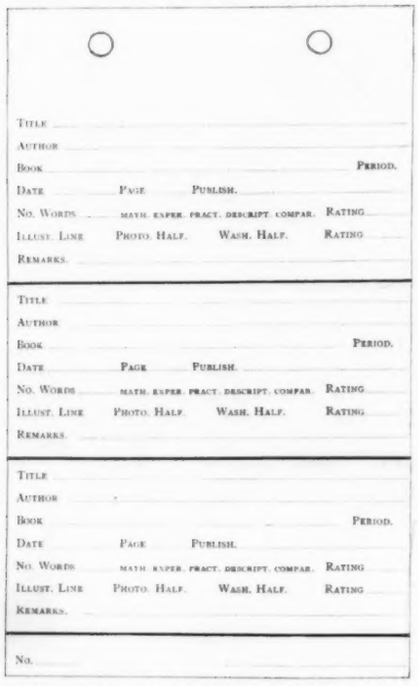
UNIVERSAL DRILLING JIG.

the back for the suds to run off, and at the front is a trough which catches the suds which run down the front and then to the back through two holes. We have a number of these jigs, which have given every satisfaction. A. G. F.

Coventry, England.

A Substitute for the Card-Index.

The advantages of the card-index system have been so persistently held up before us, and they have been so great over preceding systems, that we have been tempted to overlook the disadvantages. That there are disadvantages was brought



A SUBSTITUTE FOR THE CARD INDEX.
ACTUAL SIZE 4½X7½ INCHES.

strongly to my notice by Prof. A. L. Smith, of the Worcester Polytechnic Institute, a short time ago by a system which he uses and which, for his purpose, seems to me to have very distinct advantages. Professor Smith showed me a note book made up of loose leaves, printed as shown in the illustration. The sheet fits into the smallest size of university covers or holders, and is printed so as to be the equivalent of three ordinary index cards. He fills out each card on a page in just the same way as for a card index, but all three on one page must be for one subject. For instance, all three on one page might be references to gears; then the subject "gears" or "gearing" would be filled in at the bottom of the page. When more than one page is used, as would happen with most subjects, the pages are numbered consecutively for each subject. The sheets are arranged in the holders as fast as they are begun, in alphabetical order, and also under each subject in order of the numbers. These numbers are of use chiefly for cross references. For this purpose a sheet of the ruled paper which is made for the holders is put in with the subject written at the bottom, uniform with these sheets. Then the references to other subjects and the numbers of the sheets on which they are to be found are put in as they happen to be found.

The advantage to Professor Smith is that the whole thing is so readily portable that he can and does carry it with him. We all know that if we are running an index system we often find items that we wish to index when we have no cards with us; in fact, that we never do have any cards with us, and that also we are as apt to have need of the index when we are away from our office as when we are there. This little book, with the equivalent of a thousand cards in it, is easily carried without being in the way. The expense is about the same as for the usual stock cards when printed specially to order in lots of a thousand. The arrangement of the printing and the spaces can be varied to fit any case. I use a slightly different form from that shown, because my work is different from Professor Smith's, and others would be likely to prefer a still different one.

ENTROPY.

Shop Sketches.

It is generally agreed, by workmen as well as those in charge, that good, clean shop sketches are of great importance, and save both time and trouble, especially on experimental, repair, and rush, or other work of which blueprints cannot be had quick enough. For this purpose, different shops have different methods, some none at all.

A method for doing this important work easily and quickly, is to make the sketch on 8x10½-inch bond paper, using a No. 3 pencil, and making at the same time one, two, or three carbon copies. In this way a copy may be filed in the shop office, besides having others for the machinist, blacksmith, or patternmaker. These sketches are easily made by any one, even a boy who has been a year at the trade, who is handy with a pencil. In fact, I have used this kind of help considerably for the last few years, and their work has been satisfactory.

The enclosed samples are copies taken from our file. U. B. S.

[The samples certainly answer every purpose.—ED.]

A Ring Cutter of High-Speed Steel.

A recent advertisement reminds me of a pair of straddle mills of 12 inches diameter by 1 inch face. I knew that the office would faint if called upon to buy high-speed blanks of that size, and, moreover, I could not wait for them, as the job was wanted without delay, and several weeks' delay might be experienced before an order would be filled. Consequently I determined to use anything I could find in our steel pile. On investigation, the only thing available was a piece of high-speed steel 5 inches wide by 1⅛ inches thick, and, after consulting the blacksmith, I determined to use this. He cut off two pieces 15 inches in length, about 3 inches from either end he punched a small hole, and

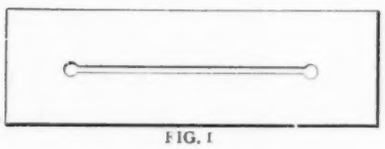


FIG. 1

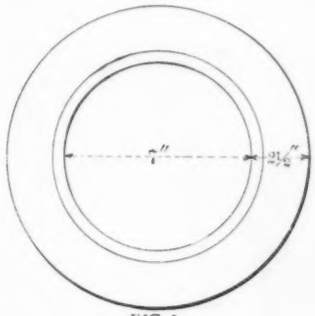


FIG. 2

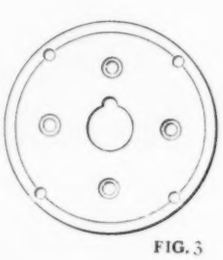


FIG. 3

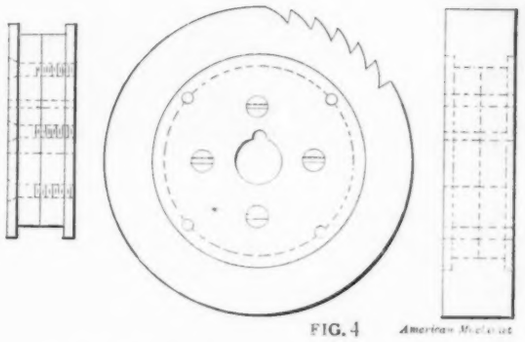


FIG. 4

A RING CUTTER.

then split the piece from hole to hole, as shown in Fig. 1. Driving a wedge into the slot, it was an easy matter to spread the steel and shape it into 12-inch rings, as shown in Fig. 2. Catching the ring in a four-jawed chuck, it was bored and squared on the edges and the sides were recessed to allow the rims of flanges to fit flush with the sides. Two flanges of gray iron were turned up to fit the rings and were pulled together with four countersunk head screws, clamping the steel ring between them. Four round pins, to act as keys, were inserted in holes drilled half in the steel and half in the iron, as shown in Fig. 3. After the ring and flanges were fitted together, the teeth were cut, and then the cutter was taken apart and the teeth hardened. After hardening the cutter was assembled again and ground all over, and, barring the four screws in the plates, it would be hard to distinguish it from a solid cutter. This pair of cutters has been in use for the past four years, though not continuously, and is still good for many more. TEXAS.

Lathe Design and Practice.

While the subject of lathe design is up for discussion, how would it do for some of the lathe manufacturers to consider abandoning their present pet practice of using odd and prime numbers of teeth on the spindle head-gear? Every man, who has ever worked at any variety of lathe work, knows that about once in every so often it would be a mighty handy thing on some special job to be able to rotate the lathe spindle one-half, one-fourth, one-sixth, or one-eighth of a turn, with a fair degree of accuracy.

With a convenient number of teeth in the head-gear, a temporary stop can be rigged in a few minutes for the odd job, and save a lot of time and effort. A job of this sort came up the other day, and as usual the head-gear had an odd number of teeth, sixty-nine in this case, whereas seventy-two would have been just as easy to use when the lathe was designed, and would have given the half, square, hexagon and octagon, or even five degree spaces if required. Why was the gear sixty-nine used? Because it never occurred to the draftsman to make it anything in particular, so long as he got his ratio. Why not? Because he never worked a lathe, likely enough.

I wrote the manufacturers of this particular lathe and they thanked me, and acknowledged the practical application of the suggestion, after which they doubtless pigeon-holed it, and there it will end. It wouldn't make much of a show as a "talking point" for the lathe salesman in the office, but it would come in mighty handy for the man in the shop sometimes.

These little trifles make what get to be known in the shop as "handy" tools, and have their influence in the end. This is especially true of lathes used on tool work where every convenience counts, and those who have used standard bench or watchmaker's lathes on fine work know how useful the ability to index by the lathe spindle is when the means is there provided ready to your hand.

It might pay the manufacturers to think of some of these handy details and take them to heart, especially when they cost absolutely nothing as in this case.

HEADSTOCK.

Some Objections to the Commercial Fillister and Flat-Head Screws.

In designing and building machinery we usually use hexagon-head tap bolts, or through bolts for fastening brackets and similar members to the frame or bed, where the machine is very large, or if it comes into the class commonly called rough machinery, or if the machine is to be exposed to dampness, and is liable to get rusty. In the lighter class of machinery, however, the hexagon-head tap bolt, or the square-head and hexagon-head cap screw should not be used if good looks and smooth appearance are to be considered, as they collect the oil and dirt in the corners, and stand up in the way to catch wipers and waste when the machine is being cleaned.

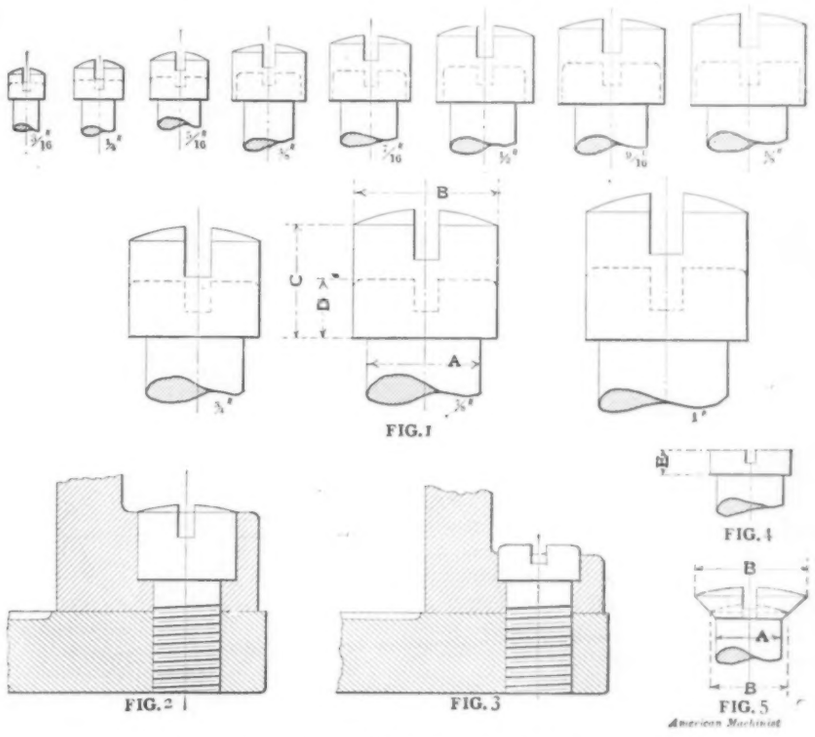
The neatest method of fastening brackets to the bed is with fillister-head or flat-head screws, as they can be set in flush with the surface by counterboring or countersinking as the case may happen to be, but the heads of the commercial sizes are much too large for the work that they have to do, and usually they are made with oval heads, as shown by the full lines in Fig. 1, so that it is necessary to counterbore to just the right depth to make the corner of the screw match the casting, and also necessary to have a thick flange on the bracket as in Fig. 2, so as to have enough metal to sink the head of the screw in.

What would present a much neater appearance and answer the purpose much better would be a screw with a head like that shown in Fig. 3; this style has a flat head with the corner slightly rounded, and it has the advantage that it is not necessary to counterbore so deep in the work, or be so particular as to the depth, as the round edge on the screw makes matching the casting unnecessary, and we do not have to make the flange on the casting so thick, as will be seen by comparing Fig. 3 with Fig. 2.

The screw heads in Fig. 1 are the commercial sizes and the suggested sizes compared, the commercial head being shown in full, and the proposed head in dotted lines; the accompanying table gives the sizes of both styles of fillister heads.

Fig. 4 is the same as Fig. 3, except that the length of the head is less and has a sharp corner; this style is intended to be set in flush with the surface. For the length of the head refer to the table. It will readily be seen that there is also a considerable saving of stock in making a large number of the thinner-head screws, and also quite a saving of metal in the castings where they are used.

In using the commercial countersunk- or flat-head screw we frequently have to make the piece larger than desired, in or-



FILLISTER AND FLATHEAD SCREWS.

der to get enough metal to bury the head of the screw. The dimensions given in the table show the comparative diameters of the commercial and the suggested heads. The screws should be made of a good tough grade of steel and case-hardened.

For tightening up these screws a screwdriver made of square stock and flattened across the corners should be used. This enables the machinist to put a wrench on the square shank, and set the screw up as tight as desired.

There is a concern making machine tools noted for their neat appearance, that uses screws of the dimensions given and they are giving perfect satisfaction.

Dimensions of Fillister Head Screws.

Commercial Sizes.

Diameter of screw = A	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
Diameter of head = B..	1/4	5/16	7/16	9/16	5/8	3/4	13/16	7/8	1	1 1/8	1 1/4
Length of head = C.	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1

Suggested Sizes.

Diameter of screw = A	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
Diameter of head.....	5/32	3/8	7/16	1/2	9/16	5/8	3/4	13/16	1	1 1/8	1 1/4
Length of head = D	.12	.16	.18	.21	.23	.26	.31	.34	.42	.47	.55
Length of head = E	.09	.13	.15	.17	.19	.21	.25	.27	.33	.38	.44

Dimensions of Countersunk Screws.

Commercial Sizes.

Diameter of screw = A.....	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
Diameter of head = B.....	1/2	5/8	13/16	15/16	1 1/16	1 1/8	1 1/4	1 1/2	1 3/4	2

Suggested Sizes.

Diameter of head = B.....	11/32	13/32	15/32	17/32	19/32	21/32	23/32	25/32	27/32	1

TABLE OF SCREW HEAD DIMENSIONS.

W. H. A.

Proving Addition, Subtraction, Multiplication and Division.

I have just read an article, "Proving Multiplication," by Geo. G. Little, at page 737. Mr. Little's method of proving the example is all right, with the exception that he has not brought his proof figures as low as he might have done before multiplying. Take a multiplicand and a multiplier of several figures and Mr. Little's method would involve too much work in the proof, viz.:

$$\begin{array}{rr} 899,889,988,998 = 102 = 3 & \\ 723 = 12 = 3 & \\ \hline 2699669966994 & 9 \\ 1799779977996 & \\ 6299229922986 & \\ \hline 650,620,462,045,554 = 54 = 9 & \end{array}$$

Note that I have reduced the proof figures of both multiplicand and multiplier to one figure, by repeating the cross addition of the figures before multiplying to obtain the resultant figure. Should the resultant come out with two figures in it, same should be reduced to one figure by cross addition of the figures.

This same method can also be applied to other operations in arithmetic, viz., addition, subtraction and division, although it is of little use in subtraction, as the work can be reviewed two or three times while the proof is being figured out. Take an example in subtraction thus:

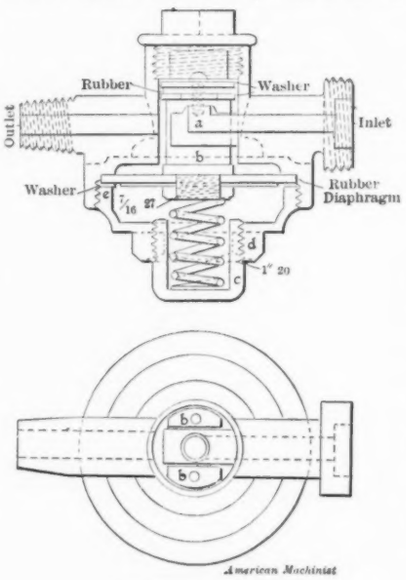
$$\begin{array}{rr} 987,654,300 = 42 = 6 & 6+9=15 \\ 899,876,527 = 61 = 7 & 7 \\ \hline 87,777,773 = 53 = 8 & 8 \end{array}$$

Note that the cross addition of the figures in the subtrahend and the minuend is carried out the same as in the example in multiplication, and the resultant figure is obtained by subtraction. In all cases where the result of the cross addition of the figures in the minuend gives a figure less than that in the subtrahend 9 should be added to the minuend figure before subtracting. This method is a proof of the correctness of the work, but does not locate the mistake if there is any.

WATSON F. WRIGHT.

A Reducing Valve.

The accompanying sketches show a simple but very reliable reducing valve, for air, water or gas, to be used anywhere where a steady pressure is required. The body is of red brass, the seat *a* is of yellow brass inserted. The valve is shown in its normal condition—open. When the air or liquid is turned on it enters at the point marked "Inlet," passes through seat *a* and through the outlet and enters the reservoir. When the pressure in the reservoir equals the spring pressure, which in this instance say is 15 pounds, it acts on the rubber diaphragm, depressing it; this in turn takes along with it the yoke *b*, on top of which are fastened two brass washers and between them a rubber disk, which presses upon the seat *a* closing it, until the pressure falls; the spring will then open and the valve begin to work again. The pressure desired is adjusted by manipulating the screw *c*, which acts upon the spring. The diaphragm is supported from below by a washer as shown, and is kept from twisting when screw-part *d* is put in, by a narrow binding washer *e*.

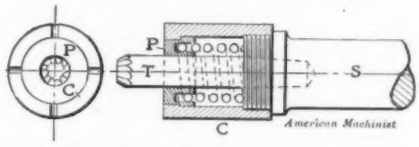


A REDUCING VALVE.

J. K.

Tool for Cutting Holes in Boiler Shells.

In the accompanying sketch I show a tool that we are using, with excellent results, for cutting holes through boiler shells and other places where the metal is thin and where punching is either not possible or permissible because of the exact position—with relation to other parts of the outfits we build—in which it is necessary to locate the hole in the finished shell. The tool was made to replace the drill or counterbore for the following reasons: An ordinary drill, unless it has very little lip clearance, or is ground with extreme care, usually produces a five-sided hole, with the rounded points falling outside of the diameter of the drill used and the curved sides inside, making a hole difficult to tap and liable to leak when finished unless first drilled with a drill under size and finished with a reamer, the reaming operation being one too many. Using a counterbore also requires a small hole for the tit. Our latest form of cutter makes this unnecessary. While the counterbore gives better results than the drill, it has its disadvantages in that, when nearly through the plate, the thin portion remaining gives so



TOOL FOR CUTTING HOLES IN BOILER SHELLS.

little bearing for the tit that, if there is any tendency on the part of the counterbore to wabble or cut large, this small bearing offers very little resistance, and the result is a hole misshapen or too large. These faults are obviated in the tool shown.

Referring to the sketch, *C* is the shell cutter, made thicker at the cutting end and having in our design four teeth. *T* is the tit, having teeth something like a rose reamer milled on the end to size the hole for the tit. Our later design uses a tit having a short twist drill on the end of *T*, leaving enough of it plain for a full bearing where the cutter *C* begins to cut. *P* is an easy fitting plunger, held out by a stiff spring inside. It acts as an ejector for shedding the washer-like cuttings made by the tool.

The form of tit shown here was first adopted because it replaced the counterbore that followed a small drilled hole, and because it was used in places where it cut holes through the shells at an angle, or through conical shells at a right angle to the axis. Here the tool best demonstrated its value, as this work gives it the severest test. The tool was also used to drill a hole through a cylindrical outer shell into a conical inner shell. The cut-

ter in this case was made cheaply, using a piece of pipe, 4½ inches diameter; the teeth were case-hardened. After cutting three holes, there was scarcely any wear and the job was excellent.

W. M. Fox.

Altering a Planer Drive.

We had an old planer which was fitted with the old-style three-pulley single-belt drive. It did not help the output of the shop, because, when it got to the ends of its stroke it seemed inclined to halt betwixt two opinions; it didn't quite know whether to go back like a sensible planer or to quit entirely. It generally decided, amid much protest in the way of squeals from the belt, to quit; then the belt would be taken up till it was as tight as a fiddle string, making it possible to run a few more strokes, but only a few—the belt, not being able to stand the extreme tension, broke, necessitating another course of mending, taking up, etc. We kept this performance up for a month or two, but eventually tired of it, letting the machine stand—master of the situation.

When the rush came and our planer department was working at full capacity we decided to alter the driving motion, and, thinking other readers may find our solution useful, I enclose a blueprint of the alterations.

The 48x3 P wheel was already on the machine, a part of the old drive. The worm gear was of gray iron, hobbed, while the worm was of gun metal. This is a variation from standard practice which would make the worm of hardened steel and the gear of gun metal or bronze, but I was advised by a friend to try this combination, as he had a similar drive which had been doing fairly heavy work for twelve months and in the teeth of which the tool marks were still visible.

holes for the box casting being shown at *A A A*.

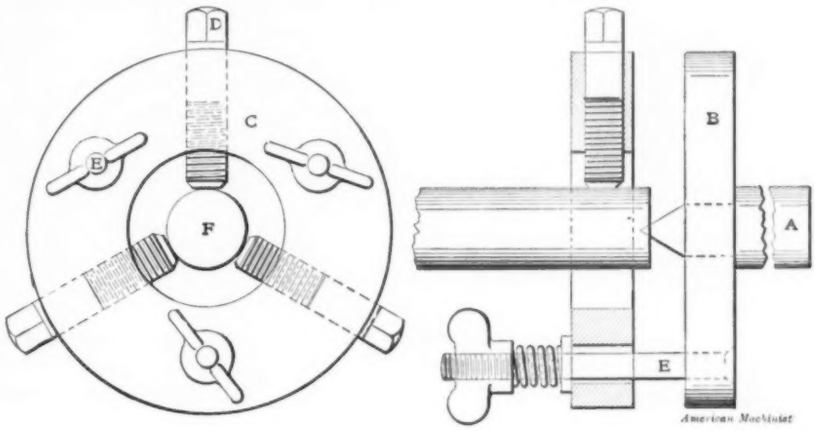
The belt bar *B* has two pairs of forks, and is moved 4 inches (twice the width of the belt) at each reversal by the lever *C*, which is keyed to the shaft *D*, to which is also keyed lever *E*, which receives its motion from the reversing motion at the front of the machine.

Another special feature is the method of lubricating the loose pulleys. They run on gun-metal bushes which are firmly secured and kept from revolving—the pulley shaft running in these bushes, which have a much longer bearing surface than usual. There are suitable oil channels cut in the bushes on the outside to carry the oil to the center of the loose pulley, where there are other holes which let the oil through to the shaft.

It will be seen that the lubricating of the loose pulleys is very easy and also very efficient. It will also be noticed that the pulleys will not require as much lubricating as usual, because, while with the ordinary arrangement and pulley speeds in relation to the loose pulleys of 1,220 revolutions, with the plan shown we increase the facilities for oiling and at the same time reduce the necessity for oiling. The cutting speed is 25 and the return speed 60 feet per minute, and squealing belts are now unknown on this machine, while the output has been increased by about a thousand per cent.

P. Laner.

Yorkshire, England.

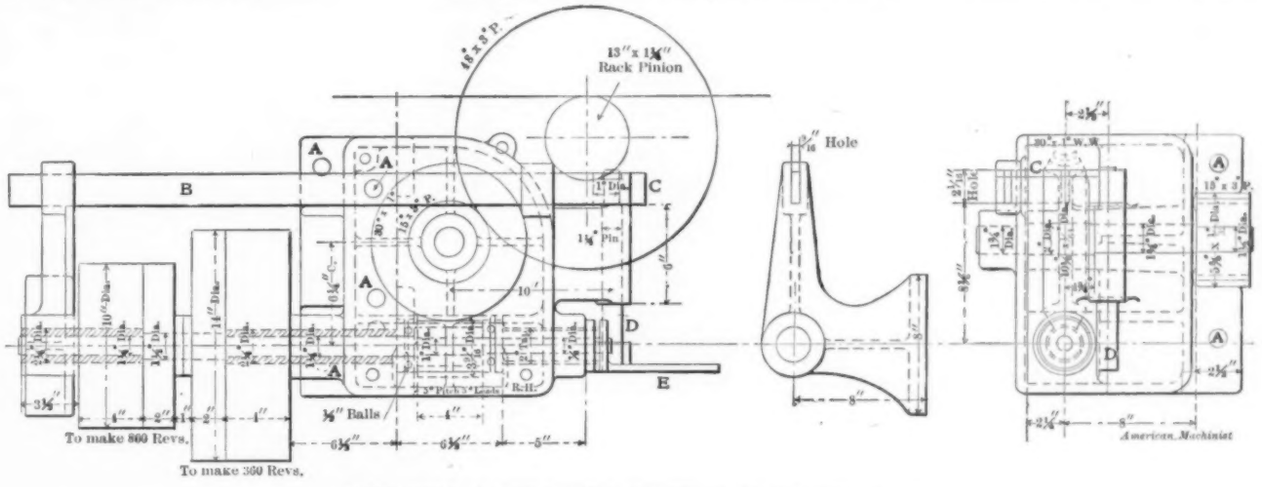


REAMER HOLDER.

A Reamer Holder for the Turret Lathe.

The reamer holder shown in the sketch, and which was made as an experiment, has been in hard service and has proven itself to be so satisfactory that a number of others like it were made for the different turret lathes in the shop.

Shank *A* is of a size to fit the holes in the turret and is turned down at the end as shown and pointed to form a center. Plate *B* is pressed tightly back against the shoulder on the shank. Ring *C* has its central hole of a diameter to admit the largest reamer shank and is fitted with the



ALTERATIONS TO THE DRIVING MOTION OF AN EXISTING PLANER.

The thrust of the worm is taken on steel balls which are provided with means for adjusting. The worm-gear case and the bracket for the outer end of the pulley shaft, both bolt to the housing—the bolt

of 360 and 860 revolutions per minute for the cutting and return, respectively, the shaft would revolve at 860 and one loose pulley in the opposite direction at 360 revolutions, giving a speed of the shaft

three screws *D*. It will be noticed that the tapped holes in the ring are threaded only for about half of their length. This was done merely to cut out unnecessary work in making and does not affect the

fixture in any way. The screws are squared to fit the regular chuck wrench.

Rods *E* run through the plate *B* and the ring *C* and contain the springs and wing nuts shown. They have tapered heads and the holes in the plate *B* are countersunk to receive them. The holes through ring *C*, which admit the rod, have clearance as shown. *F* is the reamer shank held by the screws *D*.

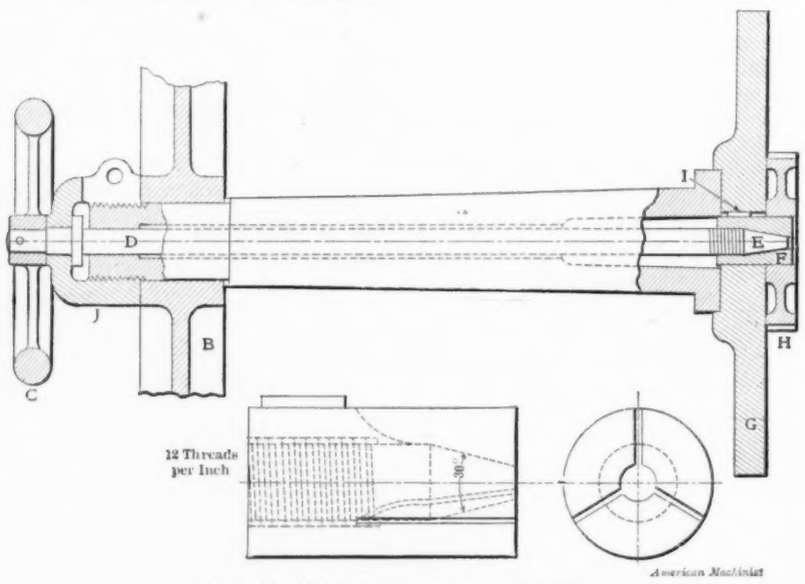
As will be seen, the spring tension can be made to hold the end of the reamer in any desired position by means of the wing nuts, and be free enough to allow it to follow the hole whichever way it may lead. Even the weight of the reamer cannot affect the cutting, as the springs will be adjusted to counterbalance it. Another great advantage, appreciated by the operator, is that any style or shape of shank can be held without the special bushings usually required.

Of course this float is not theoretically ideal as it will not give to the reamer a parallel side adjustment, but nearly all others which I have seen have the same fault, pivoting from the end as this one does. The verdict given by the shop is that this tool is cheaply and easily made and practically efficient. L. F. B.

Chuck for Holding Thin Pieces for Grinding.

Having once had occasion to design a machine for grinding thin blanks, disks, saws, etc., the question of holding the work arose. The aim was to provide means for holding the work by the hole, and at the same time drawing it against the face-plate, so as to insure that the surfaces would be parallel. It was of the utmost importance that this be done as quickly as possible, so as to reduce the time of removing the finished blank and replacing another to a minimum. The AMERICAN MACHINIST was overhauled, and the various catalogues consulted, but no draw-in chuck was found, which would do the work in one operation, or by the turning of one handle or lever.

The accompanying sketch shows a chuck which we designed to fulfil the requirements. The work spindle is shown as *A*, and is driven by gear *B*. *J* is a clamp nut for adjusting the spindle endwise, and also serves to retain the chuck-bolt *D*. This bolt *D* has the hand-wheel *C* fast at one end, while its other end is provided with a thread and tapered tip *E*. The chuck itself consists of a steel sleeve *F* fitting in the face-plate *G*, having three slits milled in its outer end for about one-half its length. A key *I* is provided to drive the sleeve.



CHUCK FOR HOLDING THIN PIECES FOR GRINDING.

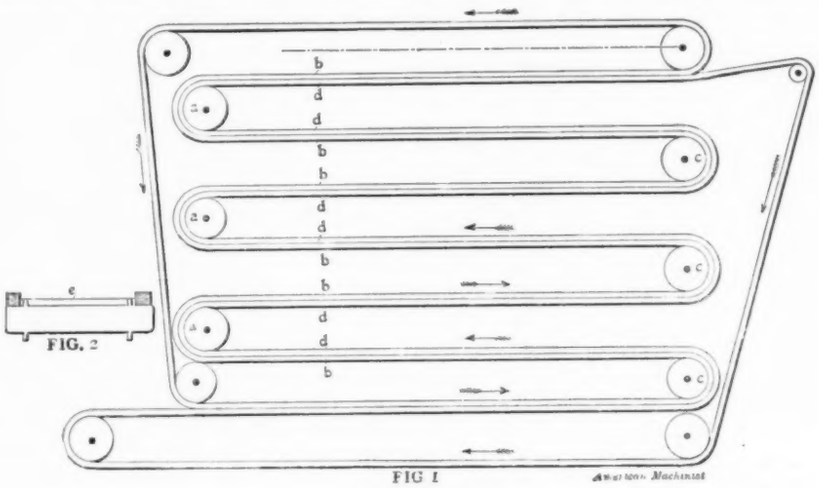
The operation is as follows: A blank *H* is laid in place, and the hand-wheel *C* is given a swing. This rotation of the bolt *D* draws the chuck-sleeve in, and at the same time causes it to expand at its outer end, thereby gripping the work and seating it against the face-plate. It was found, by purposely holding a blank about 1-64 inch away from the face-plate, that the chuck would draw it down firm, and grip it at the same time.

For blanks already keywayed, the chuck nose was provided with a key, otherwise the driving was by means of the hole in the work.

The above may not be new to some of the readers, but it was to us, and because of its excellent action, deserves to become better known. ELMER G. EBERHARDT.

A Belt Puzzle.

The accompanying diagram shows a conveyor, regarding which a question has arisen of unusual interest. On each end



A BELT PUZZLE.

of the rollers shown in Fig. 1 are two belts, as shown in the cross section, Fig. 2; size, 3-16x1⅝. When applying the power to the rolls *a*, all others running idle, the belts traveling as indicated by the arrows, belt *b* travels the faster. Again when applying the power to rolls *c*, all others running idle, the same belt *b* travels the faster, always making a uniform gain of 1 inch in each running foot. By applying the power to both sets of rolls, *a* and *c*, all at the same speed, the same condition still exists. Again applying the power to two only of the rolls *a* or *c*, the condition is unchanged. The rolls are 3⅞ inches in diameter at the crown point, all being of the same size. To support the belts between the rolls I have strips ⅞x2 inches, with a rise of 2 inches in the center, the strips being 10 feet long. The rise is to keep the belts together. The tension on the belts is as strong as it is consistent to make it without breaking the frame. The speed of the rolls is thirty-nine revolutions per minute.

By placing marks opposite each other on belt *b* they will remain so, and also when placed on belt *d*, but marks placed on belts *b* and *d* will not remain together, belt *b* always traveling faster by 1 inch in each foot.

The machine is used for conveying envelopes, each end of the envelope being held between the two belts, as shown in Fig. 2 at *c*.

Can you suggest any change that will cause the belts to travel together, or assign a reason why belt *b* should travel the faster, regardless of the source of power?

The distance between the sets of rolls is 10 feet and the sketch shows accurately the location of the rolls.

CHAS E. SCHUMACHER.

[We confess we are unable to understand the action described and offer the puzzle to our readers for solution.—ED.]

Making a Square Hole.

I recently had a number of steel worm-wheels to make which had a hole in the side cut axially, 1¼ inches square and ⅞ inch deep, which had to be within narrow limits both as regards shape and size. The remainder of the job presented no special features, and it is the method I adopted

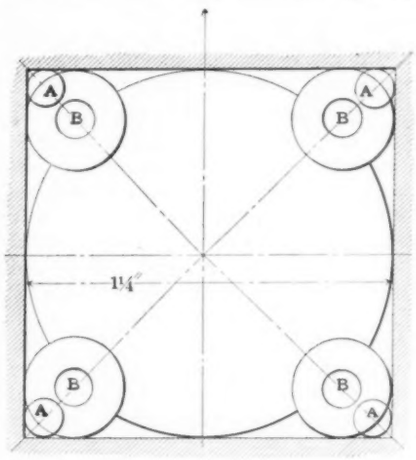


FIG. 1

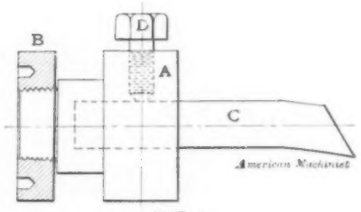


FIG. 2

MAKING A SQUARE HOLE.

in making the holes that I wish to present.

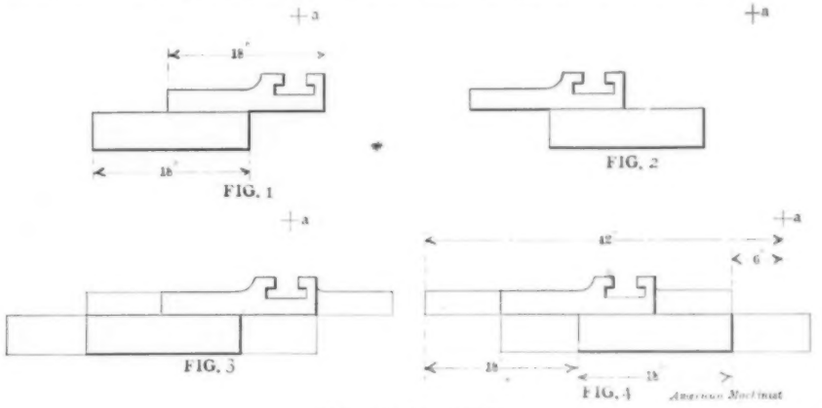
I laid out the square with a scratch-awl and then proceeded to lay out and drill the ⅛-inch holes *A A* and *B B*, Fig 1. Next I counterbored *B B* with an 11-32-inch counterbore, finishing the bottom with an 11-32-inch twist-drill ground square across. I then mounted the worm-wheels in the lathe and bored the 1¼-inch hole, finishing the bottom square, and cutting a 1-16-inch recess at the bottom large enough to clear the corners of the 1¼-inch square. By this means there was very little left to come out, as will appear from an inspection of Fig. 1.

The next proceeding was to fasten a dividing head belonging to a universal miller on the shaper table and finish the holes with the tool shown in Fig. 2, in which *A* is a machine-steel block fitted to the clapper block, and held fast by means of the spanner nut *B*, and holding the tool *C* by means of set-screw *D*. *C* is made from ⅝-inch drill rod, and only projects one inch, so that it is very rigid. By working to a stop on the vertical slide I got the square true with the outside, and the result was a first-class job in every respect.

JOHN P. WHEELER.

Lathe Design and Practice.

Since Professor Sweet invites me to "get back at him," at page 705, I will make a try at it, though from a different standpoint from what he expects. He has long advocated the use of guides and slides of equal length, and while he does not seem to have converted everyone sufficiently so that they practice what he preaches, there is no doubt but that most of us will agree as to the correctness of his position in cases where there is a constant length of travel, like the crosshead of a steam engine. The cross-slide of a lathe is a piece of which no maker can prophesy where it will be used the most, and I think a consideration of the annexed sketches will



LATHE CROSS SLIDES.

show that the task of equalizing wear is unlikely to be solved.

If I understand Professor Sweet's idea correctly, he would put two parts—one the slide and the other the guide—in extreme positions, as in Figs. 1 and 2, Fig. 1 showing the position when boring a hole (*a* indicates the center line of the lathe in all sketches) and Fig. 2 the position when turning full swing. Here the two are of the same length and each equal in length to the distance through which the slide moves. Since the overhang of the tool makes this proportion impracticable, we will add one-half the length of each part on each end, as in Figs. 3 and 4. Here it is seen that the tool is rigidly supported in all positions, and that slide and guide are of the same length. But look at the distance from the tool to the position necessary for the cross-feed handle. The dimensions given are appropriate for about a 30-inch lathe. This gives us 42 inches from the center back to the end of the slide. If the cross-feed screw is in the lower part, as usual, the handle must be out beyond that and stay there even when boring or turning small diameters. If the cross-feed screw is put in the top slide, so as to turn through a stationary nut, then the handle must be set out another 9 inches, so as to clear the corner at *c*, Fig. 3, when it is clear in. And then, too, who can predict what use the lathe will be put to? Suppose that this 30-inch lathe happens to be used entirely on small work, which is perfectly legitimate, as it may be heavy work if not large in diameter, or it may be boring holes or turning hubs on work of large size, when the end *c* of the lower slide may never get a particle of wear. If its use happens to be mostly on large work, corner *c* will take the wear and the other end go free. Thus, too, unless we should get the pressure of the tool always in the center of the length of the top slide, it will have a tendency to wear more at one end than at the other; and while we might accomplish this by cutting off the left-hand part added to Figs. 1 and 2 to make Figs. 3 and 4, it would result in the slide overrunning more at one end than at the other, which would hardly be a gain.

Take it all around, I do not see but that even with broad bearing surfaces and heavy guides, we will have occasion to rescrape the surfaces some time. If Professor Sweet will use the premium system in his shop he will have no trouble about slides getting too bad to use before refitting is done. The men will make life miserable for him if he does not keep things right up to date. I had a slight touch of the premium system, complicated with an attack of high-speed steel, and between them I had to drop it because it cost more to keep the machinery keyed up where it belonged than we profited from the increased work done. I am not alone in this conclusion, for only a few days ago a man responsible for a good lot of work told me that he bought some high-speed drills and put one machine to using them, and that they saved three day's time on the first job, and then they spent four days repairing the machine.

But, really, making the cross-slide of a lathe longer than the usual practice is not expensive, and it results in so much bet-

ter wear, or less wear, that we can get pretty close to an even wearing slide, or so that rescraping every two years ought to be enough. I have used slides up to ¾ as long as the swing of the lathe, but do not believe that cutting off the width of the carriage or further increasing the length of the slide would produce an appreciable gain. E. H. FISH.

Worcester Polytechnic Institute.

One of the largest uses of aluminum is in the manufacture of steel castings. Without the use of aluminum it would be impossible to make a large gun or armor plate. The addition of aluminum to steel promotes a solidity which cannot be obtained in any other manner. In the early days of aluminum, it is said that a greater quantity was consumed in the steel industry than in other trades.—*The Brass World and Plater's Guide.*

The Carnegie Union Engineering Building—Plans and Report of Committee.

The public competition instituted by the joint committee for the selection of architects for the planning and erection of the buildings presented by Andrew Carnegie for the American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers and the Engineers Club, resulted in the presentation of twenty-six sets of plans for the building. After a careful examination of these plans, the committee appointed Messrs. Hale and Rogers, and Henry G. Morse, associate, architects, for the three engineering societies, and Whitfield & King, architects, for the Engineers Club.

FIG. I. THE CARNEGIE ENGINEERING BUILDING.

The architects' plans embody a general scheme which is acceptable to the committee which represents the societies. The committee reports these plans herewith to the councils of the three societies named in the letter of gift, and believes that it would be of interest and service if the report should be sent to the members of all the societies.

It will be recalled that the frontage of the Engineering Building on Thirty-ninth street, between Fifth and Sixth avenues, covers five city lots, or 125 feet front, and 100 feet deep. The building law of the city of New York requires that a building shall occupy only 85 per cent. of the lot area. Advantage is taken of this requirement to have space on all sides of the building, thus giving the building a monumental appearance. The building utilizes 115 feet of the 125 feet front, and 90 feet of the 100 feet depth, the lot numbers being 25 to 33.

The Engineering Building must meet requirements in five directions:

1. It must serve the convenience of each of the individual societies, which enter the buildings as founders. This has been secured by the proposed arrangement which is represented on the society office floor plan herewith (Fig. 2). The purposes of the rooms assigned will be made clear from their designations. The working offices of the representatives of the society, the reception room, board and committee rooms, important elements of the life of the society, are on the desirable south front and are favored by the windows which look to the eastward.

2. The building must supply to the three national founder societies and also to such other organizations as may be invited to participate in its benefits as associates, such meeting rooms and auditoriums as will be required for the annual meetings, the public reading and discussion of papers, and for scientific lectures and demonstrations. In view of the number of participant societies for which provision has been made, the committee have thought it advisable to arrange for a number of assembly rooms suitable for various uses.

One of these, primarily designed for the national societies' meetings and for those of other large bodies, has been made to accommodate 1,000 persons (Fig. 3). This limit is set as being as large a number as can be expected to hear clearly the voice of a speaker. The location of this large auditorium is on the first floor above the street, so as to make elevator service for it unnecessary. Attention is directed to the large foyer and generous corridors, which give ample space for withdrawal from the large assembly hall. The ample provision for exit also at the four corners of this floor, is to be specially noticed as a desirable provision for safety. To enable auditors in the back of the auditorium to see clearly such diagrams and illustrations as may be on the stage the seats are arranged on a grade conforming to best

modern practice in theatres. This parterre arrangement enables coat-rooms to be provided, opening from the outer corridors, and special consideration has been given to secure rapid service with large numbers in attendance. It will be noticed, further, that the large auditorium floor is reached from the great central rotunda on the street floor (Fig. 4) by generous stairways, and that it can also be reached from carriages entering the driveway and moving continuously as they receive or discharge their passengers. The room for preparing apparatus and exhibits for the stage is conveniently served by a large freight elevator, so that heavy machinery and apparatus can be easily handled.

FIG 2. PLAN OF ELECTRICAL ENGINEER'S ON TENTH FLOOR.

On the floor above the large auditorium are two assembly rooms (Fig. 5) occupying the principal portion of the area. These assembly rooms may be used independently for lecture purposes, or one may be made auxiliary to the other and used as a foyer or conversation room. As to the two rooms adjoining they may be used in common when desired, as, for instance, for purposes of general reception or conversazione. Auxiliary smaller rooms on this floor are provided, and provision is made for the service necessary for light refreshments or luncheon.

On the floor above (Fig. 6) a number of small lecture halls are provided suitable for ordinary meetings of scientific and engineering societies, and for meeting of sections at the time of general conventions of national organizations.

It is expected that there will be a great demand, especially for the small meeting rooms, for scientific purposes. They will be supplied with electric current, with compressed air and with gas and water. The meeting rooms of all sizes will be fitted for the use of the projection lantern, and will be unique in their completeness for the purposes for which they are intended. The board rooms of the society floors will be large enough for the holding of small professional meetings when occasion may require.

3. A crowning detail, in the planning of the building has been the provision on the two upper floors for the libraries of the various societies (Fig. 7). It is the purpose of the societies so to administer the library of each that by bringing them together there shall be created a working and reference library of the highest possible value and completeness as respects engineering science and practice, which shall be unequaled anywhere. The societies have recognized that there is before them as unexampled opportunity, and it is their desire to avail of it to the highest degree. In seeking this end the entire top floor is to be devoted to reading and reference rooms, to working alcoves, to rooms for photographic reproduction, and for drawing and similar library work. The roof will be specially constructed to secure the best illumination. The location of the reading rooms at the top of the building will be quiet, cool, airy, and free from dust. The floor below the library reading rooms will be devoted to the book stacks, although when first the societies enter the building, the alcove construction in the reading and reference rooms will take care of the nucleus of the future library which the societies will bring with them. This will leave the book stack floor for growth, as the library shall increase in size hereafter. It is believed that, by the co-operation of the New York Public Library on the adjoining block, and with the interest and strength which the societies will furnish, the library in the Engineering Building can be made the most important engineering library of the country. The committee has tried to provide ample space to accomplish this end.

4. The building is also to furnish office accommodation for a large and continually increasing number of societies which have engineering or some other department of science as their principal object; such are, for example, The New Electrical Society, The Society of Naval Architects and Marine Engineers, The Heating and Ventilating Engineers, The American Gas Light Association, The National Electric Light Association, The Society of Chemical Engineers, The Association of Edison Illuminating Companies, and many others. For the organizations the building will offer office areas of varying sizes, whose arrangements will be adjusted to the requirements of such participants as shall

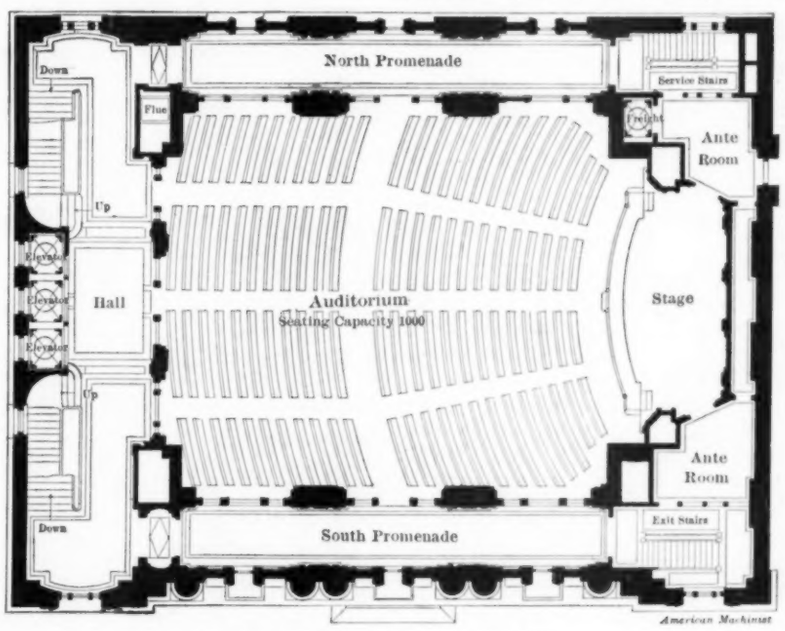


FIG. 3. AUDITORIUM ON THIRD FLOOR.

hereafter be made known. Such participants will have use of the auditoriums of the desired size.

5. The building must also serve as a business office for the founder and associate societies. Attention is called to the driveway (Fig. 4), whereby access is had on the street level and under cover to the freight elevator, both for boxes of books and for other merchandise moving inward and for mail sacks moving outward. This driveway also serves for carriage access to the auditorium and passenger elevators. It gives facility for unloading by gravity to the coal pockets of the heating plant without handling. The general convenience of the building is also served by the receiving and shipping office at the rear, through which all goods in and out will be handled. There is also the bureau of information, at the right of the main entrance, where general questions can be answered, visitors directed, and some routine business transacted. This office will also be a suitable location for the telephone exchange, the telegraph and the sub-post-office.

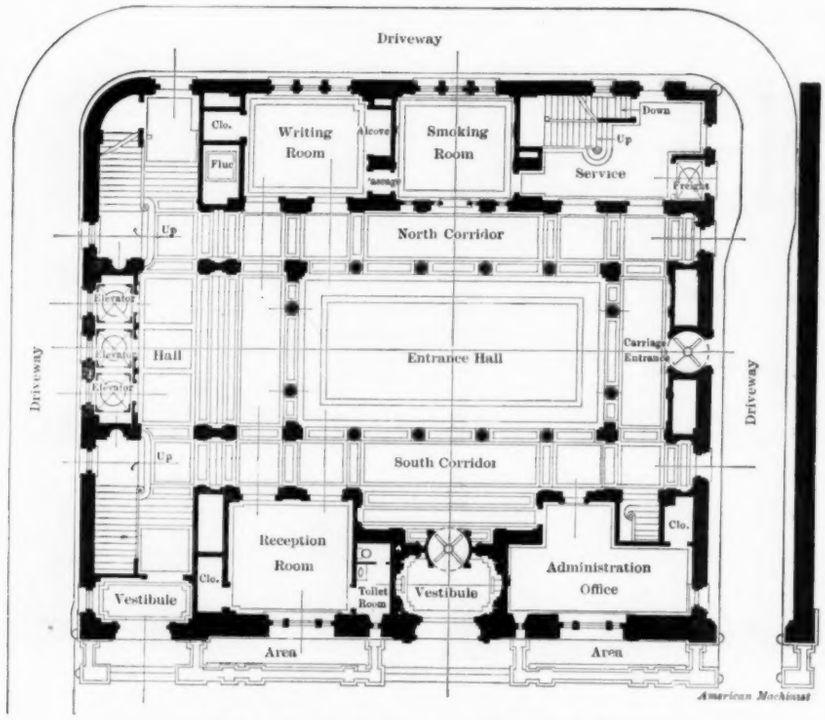


FIG. 4. PLAN OF ENTRANCE OR FIRST FLOOR.

By a business arrangement formed under legal advice and forming part of the deed to the property to the east of the building, a restriction has been placed which prevents the erection on that lot of a building more than 60 feet high. This restriction runs with the land and secures light and air for the building on its eastern front above the third floor. The westerly wall is built 10 feet within the property line, so that openings for light and air should always be left on that side and on the rear, even if high buildings should be hereafter built on adjoining property to the west and the north. The committee contemplates finishing the building on all four sides and not merely on the south façade, in order that its monumental character may be seen and recognized from every point of view.

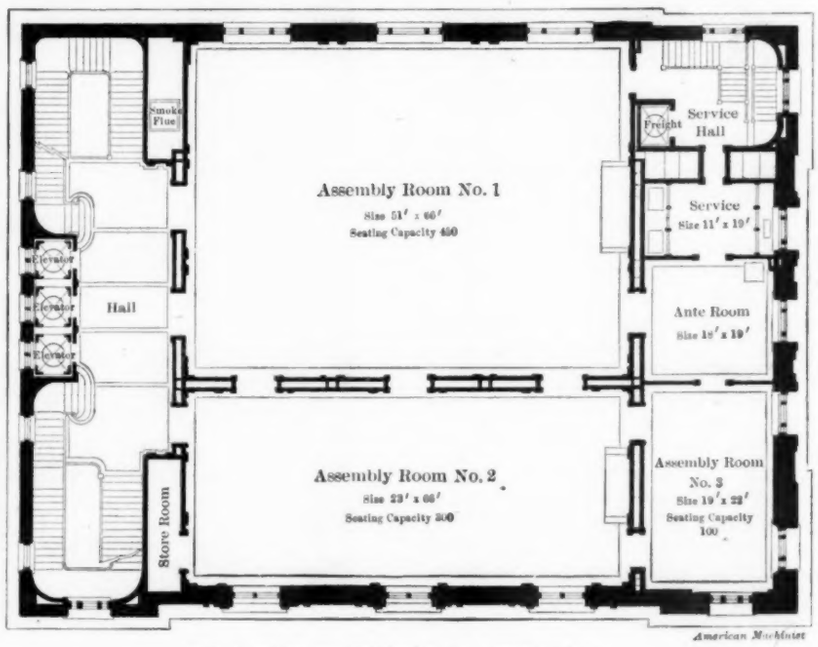


FIG. 5. PLAN OF ASSEMBLY OR FIFTH FLOOR.

It may be serviceable to remind members of details which have been presented at various times concerning the organization of the holding corporation which is to administer the building for the founder and associate societies. This corporation was formed by special charter in the State of New York, in May, 1904, and is called "United Engineering Society." Its nine trustees are chosen, three each, by the councils of the electrical, mechanical and mining engineers, and control the building and are responsible for its financial administration. Its charter and by-laws have been the occasion of much careful thought by the societies and by legal counsel, and the title to the land rests in this body corporate. The land passed to these trustees in January, and they are paying the interest and other expenses during construction. It is the unusual character of the trust and its functions which are largely responsible for the delay in beginning construction.

The contract for construction was signed in July, the excavation for the foundations was started at once, and the work of construction has now commenced. The contract limit is fifteen months to date of expected completion.

Are There Any Safe Fly-Wheels.

BY WM. H. BOEHM.

The disastrous fly-wheel wreck at the Cumberland rail mills leads to the question, are there any safe fly-wheels? The exploded wheel was of modern construction, it was made of material known to be flawless, and it was operated normally at a speed known to be amply safe. It exploded not because of any fault of its own, but because of an accident to the mechanism of the engine which allowed it to race and burst the wheel by centrifugal force. This was not a "fly-wheel accident," but an engine accident resulting in a fly-wheel wreck.

This accident does not differ from hundreds of others. Just recently a perfectly

sound fly-wheel exploded in the Licking rolling mills, doing an immense amount of property damage. The explosion was caused by an accident to the engine. The bursted wheel was replaced by a new one built as strong as the best of engineering skill could make it. The new wheel exploded just as the first one did—because of an accident to the engine.

The case of the Licking mills is duplicated, except as to the extent of the damage, by the fly-wheel accident which has just occurred at the National Tube Works. Here an engine exploded a fly-wheel 30 feet in diameter, killing five men outright, fatally injuring one more, dangerously injuring six others and causing a property damage estimated by the McKeesport *Times* to be between $80,000 and $100,000. Only nine months ago this same engine exploded a fly-wheel, killed one man outright, seriously injured three others and caused damages to the plant estimated at $100,000. Both explosions were precipitated by accidents to the engine.

Several years ago an engine in the Hoboken electric light plant exploded a perfectly sound fly-wheel, killing the engineer, and partially wrecking the plant. The engine was repaired, equipped with a new fly-wheel, and sold to the Northampton Portland Cement Company. It ran there only a short time, when it duplicated its previous performance by exploding the new wheel, killing another engineer and again wrecking the plant. Both explosions were caused by accidents to the engine.

We have mentioned these instances where more than one fly-wheel has been exploded by the same engine because they emphasize the point that all fly-wheels, however sound and however strong they may be, are entirely at the mercy of the engine upon which they are located.

The answer to our question is that *there are no safe fly-wheels.* No one can expect mechanism, particularly the complicated mechanism of a modern steam engine, to run continuously, day in and day out, without sooner or later becoming deranged or having some accident happen to it. And when an accident happens to the engine a fly-wreck wreck, with all its disastrous consequences, is almost certain to follow.

No fly-wheels are safe for the simple reason that they are all attached to engines, the mechanism of which is likely at any moment to get out of order and so accelerate the speed as to burst the wheels. It is for this reason also that fly-wheel wrecks occur more frequently than boiler explosions.—*Power.*

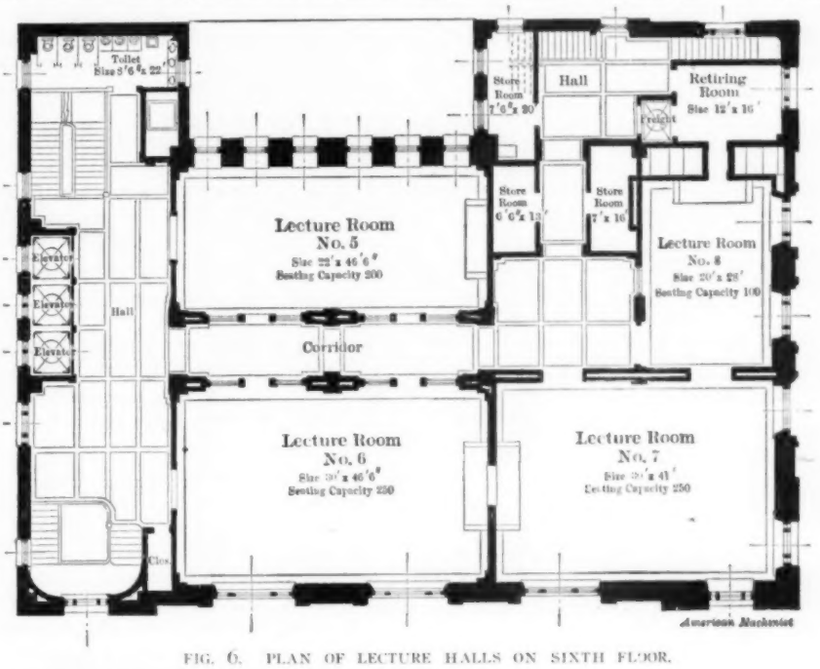


FIG. 6. PLAN OF LECTURE HALLS ON SIXTH FLOOR.

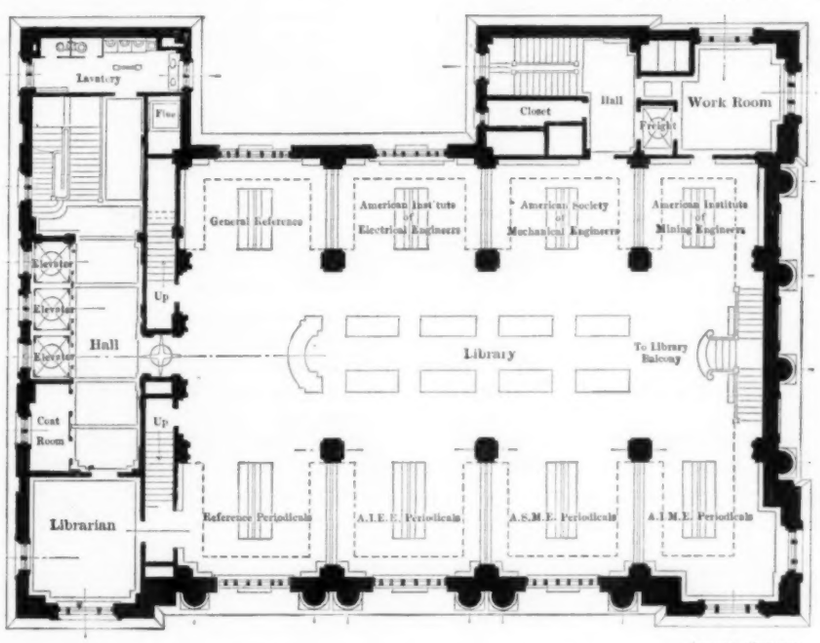


FIG. 7. PLAN OF LIBRARY ON THIRTEENTH FLOOR.

Pittsburg will look still less like "hell with the lid off" after the first of the year, when the hot slag trains from the blast furnaces of the Carnegie plants will be discontinued. Hereafter the slag will be moved and dumped cold.

These slag trains are about the last of the old time fiery glories that made Pittsburg's environs picturesque at night. Years ago the "Canada tops" put a stop to the great bursts of flame that used to come from the blast furnaces when charges were dumped into them in the old fashioned way and, incidentally, saved the heat. Then open-hearth steel furnaces began to displace Bessemer converters with their magnificent towers of golden flame, the open-hearth furnaces showing no fire at all. The slag trains continued a picturesque feature of the Monongahela river banks at night, but now they, too, are doomed.

By the new process slag is passed under a spray of water as it is poured from the furnaces into the cars to be removed. This causes it to break into fragments and cools it so that the trains loaded with it are no more picturesque than trains loaded with pig iron. The granulated slag is used for railroad ballast and other purposes.—*Pittsburg Dispatch.*

Visitors to the Exposition at St. Louis will remember the de Glehn four-cylinder balanced compound locomotive, which the Pennsylvania Railroad imported from France for experimental purposes. This engine having been built where the metric system is standard, and having been recently damaged in a wreck, now gives the shop men a chance to try their ability at metric conversions, in working to the metric system, or fitting to metric parts other parts made to English measurements.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1905 *the* AMERICAN MACHINIST *printed and circulated* 1,059,100 *copies, an average of* 20,367 *per issue. Of this issue* 17,750 *copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.*

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Catalogue Houses and Parcels Post.

We have before referred to the fight which is being carried on by certain organizations of hardware dealers, and in the columns of our chief hardware contemporary, against the "catalogue houses." These dealers and the conductors of the journal referred to seem to think that because those who conduct catalogue houses do not do business in the way it always has been done, and in the way that is approved by custom, they have no right to be in business at all, and have been trying to so fix things that they would have to go out of business so far as the hardware trade is concerned; but apparently the more they try this, the more vigorous the catalogue houses become, and the more business they do in the line of hardware. One reason for this is stated by one who signs himself "Another Missouri Retailer," and who says that the retailers have been deceived by certain jobbers who have been urging them to join in the fight against the catalogue houses, and at the same time selling to those same houses.

We suppose that in the end these people will discover that the way to meet the competition of the catalogue house is to so arrange things as to make it plain to buyers of hardware that the regular dealers are doing as well by them as can be done by catalogue houses or anyone else, and if that cannot be made plain, then by every commercial law the regular houses do not deserve the business. This is the principle which has controlled in manufacturing operations for many years, and still controls where such operations are not under the dominion of a trust. There is no reason why the same principle should not apply to commercial operations. In the meantime, these people are now joining forces with the express companies to prevent the enactment of a parcels post law, such as has been inaugurated in practically every other civilized country on the globe, but which we here are compelled to get along without as best we may, chiefly because the express companies oppose the giving of this boon to the people, and are seconded in their opposition to it by those who fear the catalogue houses and think they would do an increased business if they could send goods by mail. In the same number of our contemporary which contains the letter above referred to, opponents of the parcels post are warned that they must act promptly in order to prevent the enactment of a bill intended to secure the parcels post for this country during the present session of Congress; and in the meantime every sender of a Christmas gift, every person who wishes to send any sort of a package to a friend, and every manufacturer who must have a certain article quickly, or must send or receive a repair part in the shortest possible time, must pay an exorbitant price for its carriage, simply because it happens that the imagined interests of certain hardware dealers, and the undoubted interest of certain men who own the express companies are inimical to the interests of the whole people; who, naturally, would like to have a decent carrying service at a reasonable price. For it is to be noted that on small shipments of freight in this country the service is usually as bad as anything could well be. There is no assurance as to time; the roads will deliver the goods when they get ready and not before, and if time is of any importance whatever, then goods must be shipped by express at a rate which is much higher than is necessary, and which would be reduced if we had the same or a similar parcels post to that which is enjoyed by practically every other civilized country.

The situation at present, and in view of the fact that we have a parcels post arrangement with foreign countries, brings about the peculiar fact that if one wished to send a package from Boston to Worcester, a distance of forty miles, by mail, he could mail it to London and it could then be mailed from there to Worcester and would reach its destination at less cost than would be required to pay for it to go direct from Boston to Worcester.

The fact is that the express companies have no real right to exist. They perform a service which should be performed by the railroads themselves at a reasonable cost, or which should be performed by the Government in connection with its post-office organization. And those who opose so obvious a reform as this, simply because they imagine that the immediate interests of the class to which they belong, or which they serve, would be prejudiced by it, are placing a very low estimate upon the value of their citizenship.

The Campaign for Pure Food.

According to a press report, the efforts of the Department of Agriculture to bring about some improvement in the situation with regard to food adulteration, especially the adulteration of those foods which are imported from foreign countries, have not resulted in a falling off in the trade in the articles, as might have been expected, but have actually resulted in increased business in many instances. While this is gratifying as an encouragement to honesty, and the fact that it is so may lessen the opposition to reform in this matter, it is nevertheless obvious that the work of securing pure food, or food which is exactly as it is represented to be, should go on with unabated vigor until it is reasonably certain that a man who buys and pays for a certain article of food shall get just that and nothing else, regardless of its effect upon business. The selling of adulterated articles of food or things which are preserved by chemicals or substances which may or will be injurious to those who consume them, is a particularly despicable and scoundrelly

form of swindling, and there should be no consideration whatever for those who do it, at least so far as the possible injury to their business is concerned, resulting from the regulation of the trade or the penalties that may be imposed for such adulteration.

The question of food adulteration is one which particularly concerns wage-workers. They are perforce obliged to consider the prices of things they buy, and where they have no means of determining for themselves which of two articles may be adulterated, they naturally feel compelled to take the cheaper, which often proves not only the dearer in the direct and ordinary sense, but far dearer when its effect upon themselves and their children is considered. Every wage-earner ought to take an active interest in the propaganda for pure and unadulterated food.

Many things come to our notice which make it seem desirable that the modern attachment to a manufacturing establishment, known as the publicity department, needs to keep always in close touch with the engineering department. Some of them keep in close touch all the time, others only a part of the time, and still others apparently not at all. In a recent case of a story sent out by the publicity department of a manufacturing establishment, we are informed that electricity has practically superseded steam as a motive power in modern buildings, and as an example of this some description is given of a modern building in which it is stated that there are an enumerated collection of generating units, consisting of various generators, direct-connected to certain specified engines. Presumably the engines are driven by steam, and we fail to see how, in this case, the alleged fact that electricity is superseding steam is proven or illustrated.

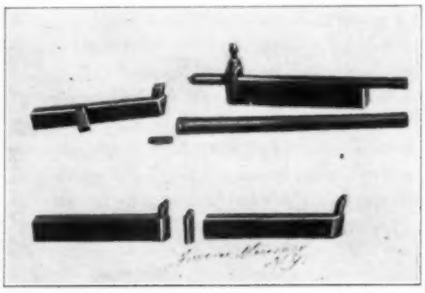
One of the special consular agents sends a report from China regarding the American automobile trade in that country. It seems he has discovered some difficulties in this trade, and he volunteers considerable advice to American manufacturers, among which we find that they should "give prompt attention to filling and shipping orders," and that "any misrepresentation as to the time of shipment should be scrupulously avoided." We have an impression that there are a good many who believe that these points ought to be observed for domestic as well as for China trade, and especially in these times of extraordinary rush in manufacturing operations, the admonition to ship promptly, and never to misrepresent about the date of shipment, has its humorous aspect.

A guard on a saw may seem something of a nuisance, but it's not half as difficult to get along with as a missing finger.—*The Wood-Worker.*

New Tools and Machine Shop Appliances.

TOOL-HOLDERS.

Of the two holders for diamond points shown the one to the left is for the planer or shaper and the other for the lathe. The holder above for the half-diamond can be used also for side tools. The boring tool holder is for bores 5/8 inch and smaller in diameter. The tools are all of high speed steel. The diamond points are of square stock and have shanks which

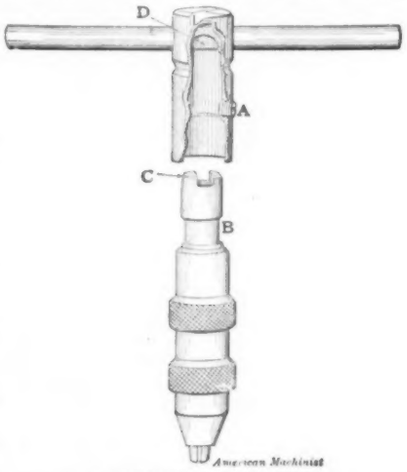


TOOL HOLDERS.

are tapered to drive into the holder which is made with a square socket having the proper angle to give the tools the right clearance both for lathe and planer use. The same style of socket is formed in the boring-tool bars, which are made of crucible steel. The half-diamond holder is also of crucible steel and the tool has a tapered, dove-tail shank which allows it to be driven in and out of the holder. R. M. Clough, Tolland, Conn., is the maker.

A RATCHET TAP WRENCH.

The illustration shows a handy little ratchet wrench for taps up to a 1/4 inch diameter. The lower part, which carries

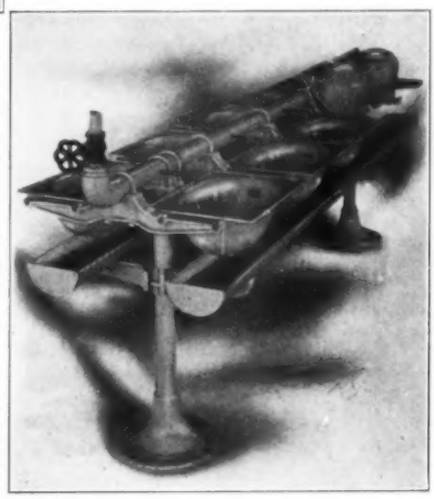


A RATCHET TAP WRENCH.

the chuck, is slotted at *C* to form a ratchet. The upper part, in which the handle is secured, is bored to receive the stem of the lower part. The screw *A*, when screwed in flush, allows the lower part to move up and down within the limits of the recess *B*, engaging and disengaging the ratchet *C* with the flatted part *D* of the handle. Screwing *A* in against the stem of the lower part converts it into a solid wrench, or removing the screw permits the lower part to be detached and used as a chuck. This tool is made by F. G. Marbach, Medina, Ohio.

SANITARY SHOP WASH BOWLS.

The accompanying illustration shows a new shop utility designed to meet the growing demand for better conditions for the welfare of the employees, and for a better equipment on the part of the employer. The main features are individual enameled iron bowls, with a separate water supply for each and a common drain. Each bowl is equipped with the overflow, waste and stopper, and holds a little more than one gallon of water. The supporting brackets are attached to the common supply pipe, which in turn is carried upon pipe pedestals. These pipe



SANITARY SHOP WASTE BOWLS.

pedestals also carry adjustable brackets supporting the drains. By means of this adjustable feature the drains can be given any desired pitch, or set at the most convenient height for connecting to the trap or sewer. The individual supply nozzles are tapped into the supply pipe enough off center with the bowls to be out of the way when the bowls are in use. As shown in the illustration the water supply is controlled by a single valve; if desired, however, bibbs can be substituted for the plain nozzles, and the water supply controlled by the person using the bowl.

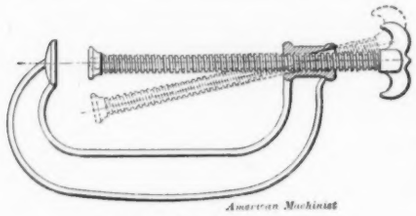
As cleanliness is of prime importance in an article of this kind all parts must be accessible. This feature has been most carefully considered. In addition to the bowls being readily removable, leaving the entire frame exposed, they can be turned over and rested upon the supply pipe, which affords easy access to the drain and the bottom of the bowl.

These bowls are made in single or double batteries of any desired length by

the Manufacturing Equipment & Engineering Company, East Boston, Mass.

QUICK-ACTION CLAMP.

The engraving shows a machinist's clamp which is adapted to quick adjustment, the boss through which the screw passes being cored in such manner that the screw can be tilted through an angle

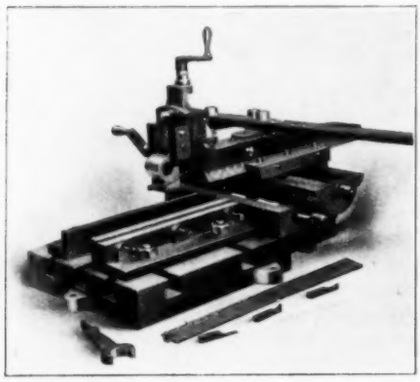


QUICK ACTION CLAMP.

of about 12 degrees, which permits it to be disengaged from the thread and moved endwise to any desired position, after which it may be tilted back and re-engaged with the thread in the nut. The frame of the clamp is a malleable casting. The screw has a ratchet-thread and is cut from the solid bar; the head is a malleable casting pinned to the reduced end of the screw, while the thrust-washer at the other end is also malleable iron and riveted to the screw so that it can turn freely. The clamp is made in various sizes up to 10-inch by the Good Manufacturing Company, Chicago, Ill.

A HAND-POWER BENCH SHAPER.

The illustration shows a handy little bench shaper for small work. Its capacity is 8x10x2½ inches. The stroke—operated by hand—is adjustable. The head can be swiveled to an angle. The longitudinal feed is either by hand or automatic, and



A HAND POWER BENCH SHAPER.

in either direction. All slides are adjustable to take up wear. It is made by the Midget Machine Company, 27 West Grand street, Elizabeth, N. J.

MULTIPLE-SPINDLE DRILLING ATTACHMENT.

An attachment for multiple drilling recently brought out, consists of a taper-shank which may be made to fit any drill-press spindle, and a cylindrical case within which are gears which drive the smaller spindles; these being arranged in such form and with such center distances as may be called for by the job for which the attachment is made; the attachment being in each case made to order for the work it is to do. The outer case is held from rotation by a light bar, and spur gears are used for the driving. The device is made by Francis Reed Co., 41-43 Hammond street, Worcester, Mass.

A LATHE ATTACHMENT FOR BORING.

This attachment is secured to the carriage of the lathe and converts it into a horizontal boring machine. A housing is bolted to the rear of the lathe carriage. One member of an angle plate is fitted to a slide on this housing and is adjusted up or down by a screw. The other member projects toward the front of the carriage, forming a shelf provided with T-slots for the work-holding-down bolts. Two small angle plates are bolted to the front of the carriage. The vertical members of these angle plates are slotted vertically for bolts which are used to clamp the front of the shelf when it is set to correct height. This device is made in all sizes by H. B. Underwood and Co., 1025 Hamilton St., Philadelphia, Pa.

Alumni Meetings of Pratt Institute.

The Pratt Institute Evening Machine Alumni Association is holding a series of monthly meetings this Winter at the Institute in Brooklyn, and among the technical papers yet to be presented at these evening meetings will be one on physics, by Prof. Jamieson on February 18, 1906, and one on the CVonstruction and Operation of the Printing Press, by L. Warner, and Ritter, on May 17.

In the works of the Brown & Sharpe Manufacturing Company, at Providence, it may be noticed that a good many of the machine tools are driven by leather link belts, and inquiry develops the facts that wherever in that works the duty required of a belt is exceptionally heavy, these link belts are put on in place of the ordinary plain belts, and they report that there is after this no further trouble; the link belt appearing to be much stronger and capable of conveying a great deal more power than can be conveyed by the ordinary belt. The Brown & Sharpe Company have dies for the purpose and make these belts themselves, their belt man attending to the manufacture of them for their own use.

The Greencroft Mill, Hyde, one of the oldest mills in Lancashire has just exchanged a very ancient beam engine for a steam turbine, passing at one step from the type built by James Watt and supplied just one hundred years ago to the very latest type of prime mover. The original beam, which worked to the last hour, consisted of two long plates of iron 1½ inches thick, held apart by studs.—*Indian Textile Journal.*

Pointers for Would-be Exporters to England.

Consul Williams, of Cardiff, Wales, in a report upon the demand for United States products, makes the following instructive remarks:

BETTER BUSINESS METHODS NECESSARY.

To introduce American goods necessitates the adoption of better business methods by Americans. To quote the Spectator, "the Englishman has a natural distrust and dislike of what is new." He has had some experience with "new" things from America, and his attitude is perfectly natural. It may be noted also that the American advertising methods are not understood here, and much of the money spent on advertising literature is wasted. There should be English editions to all catalogs and advertising circulars, using English spelling, phrases, as well as measures, wieghts, and money. It is ridiculous to expect an Englishman to buy a dictionary of Americanisms in order to understands a catalog. Furthermore, abbreviations should be avoided, every article should be illustrated, and net prices in England should be quoted.

It is well to remember, however, that it requires salesmen to sell American manufactures in Great Britain. These salesmen should be qualified. They should know everything about the articles they sell, and all about the English system of buying, credit, etc. They should leave all their bristling American ways at home, and should be equipped with a store of patience and time. The English business man will not experiment with goods or machinery until convinced that it will pay him to do so. The one item to be emphasized above all others is the durability of the article sold. This is regarded of much more importance here than in America, where the desire for the latest in everything is paramount. Cheapness is a recommendation, other considerations have weight, but it is durability that sells the manufactured article here.

DEFICIENT POSTAGE.

One small item, too often overlooked by American shippers, is postage. A small bill of goods was shipped by a large firm to this district recently, and when the statement was mailed the mailing clerk inserted a circular doubling the weight and then put on only a 2-cent stamp. When the buyer received the statement he had to pay the postman 8 pence, or 16 cents, for underpaid postage. Pence count in England and Wales, and this did not put him in a happy frame of mind to peruse the statement. In another instance brought to my notice the postage collected was 10 pence, or 20 cents. Americans should remember that twice the underpaid postage is always collected in Great Britain. Remembering this, they will be more likely to have attention paid to their catalogues and circulars mailed to British merchants.

Laundered Air.

In the office building of the H K. Porter Company at Pittsburg, Pa., an apparatus has been installed in connection with the heating and ventilating system, whereby the air is washed and all dust and soot removed before it is put in circulation. This device, installed by the B. F. Sturtevant Company of Boston, Mass., consists of a metal supporting frame filled with coke over which water trickles. All air entering the building is drawn through this filter by means of a fan and delivered under pressure to the various rooms. It is stated that during the past summer the fan has been operated continuously with the windows closed, the air has been thoroughly cleansed, its temperature lowered, the health of the office force improved and their daily output increased.

A published account of this system has stirred the muse of the *Louisville Courier-Journal* to perpetrate the following:

I can stand for tainted money, I can
stand for tainted grub;
I can drink polluted water and employ it
when I scrub,
But since noting this invention I shall
never, I declare,
Be content again with breathing anything
but laundered air.

Give me clothing filled with shoddy, filled
with microbes, if you will;
Let a million microbes bite me when I
touch a dollar bill;
Let the germs come swarming o'er me
when I take an easy chair,
But I pray you do not give me anything
but laundered air.

If ozone may be laundered, can't we
neatly crease it too—
Hand it round in snowy bundles like the
laundry people do?
Oh, I hope the time is coming when to
laundries we'll repair
Bright and early Monday mornings for
our week's supply of air.

New Publications.

"Manheim and Multiplex Slide Rules." By L. W. Rosenthal. 59 4x7-inch pages, illustrated. Eugene Dietsgen Company, New York, Chicago, San Francisco and New Orleans.

This pamphlet is a manual intended to accompany the slide rules made by the publishers. It is non-mathematical and simple in its explanation, and gives more attention than usual to the uses of the scales of sines, tangents and logarithms. Part II treats of the Multiplex rule of the publishers, by which many problems may be solved more quickly than by the usual form of rule.

"Entwurf von Schaltungen und Schaltapparaten" (Schaltungstheorie). By Robert Edler, engineer, professor in the Technical Industrial Museum at Vienna. Vol. I. 192 5¾x8¾-inch pages, with 186 figures. Dr. Max Jaenecke, Hanover, Germany. Price, 6 marks; bound, 6.80 marks.

This is a hand-book on electric switches and connections, evidently intended for use in practical layout. The first volume, now before us, treats of fundamental principles and some special applications in lighting, storage-battery connection, crane, automobile and street-railway work, etc.

"Cours de Mécanique Appliquée Aux Machines." By J. Boulvin. Fourth part. Second edition. Steam Generators. 320 6½x10 inch-pages, with 204 figures. E. Bernard, Paris.

The author, whose official titles are too long to print here, has founded the series of text-books to which this volume belongs upon a course at the special school of engineering at Ghent. It is stated that the work has been crowned by the Academy of Sciences. In substance, it is a book of industrial physics, relative to the production and transmission of heat, the types of boilers shown for examples being chiefly those built or in use in Belgium. Locomotive and marine boilers are mostly reserved for another volume. Boiler accessories and piping are considered to some extent. The new edition includes added matter on determination of the calorific power of coal, gas analysis, boiler testing rules, new systems of boilers, flow of steam in pipes, entrained water, superheaters and other subjects.

"Numerical Problems in Descriptive Geometry." By G. M. Bartlett. 62 5¼x7½-inch pages, with 18 illustrations. Published by the author, Ann Arbor, Mich. Price, 50 cents.

This pamphlet is a collection of nearly five hundred problems in descriptive geometry, many of them original with the author. Teachers desiring exercises for their class-room work can hardly fail to find here problems suited to all classes of students.

"The Industrial Problem." By Lyman Abbott. 196 5x7½-inch pages. George W. Jacobs & Co., 1216 Walnut street, Philadelphia. Cloth, $1, net.

This book consists of the William Levi Bull Lectures for the year 1905, which were delivered by the distinguished author and editor of *The Outlook*. The subjects treated are viewed from the standpoint of applied Christianity, and after a general review of the problem a threefold solution is presented: (1) Political, or government regulation of capital and labor; (2) economic, or reorganization of industrial society, so as to make tool owners and tool users more unified; (3) ethical, or a moral and spiritual regeneration of the individuals composing society. It is evident that the author is strongly impressed with the idea that workmen are in a sense partners in the establishments in which they work, and that the obligation of society to them is not complete when they are paid their wages. He emphatically indorses the organization and maintenance of unions, but as emphatically condemns some of the things which unions do. But in commenting upon these things, he calls attention to the fact that similar evils attend other organizations, civic, political and even religious or church organizations. Though some of the statements made will appear startling to many readers, we think upon the whole, those who read and reflect upon them dispassionately, will not consider them very radical, and the attitude of impartial fairness of the author is apparent in all that he says.

"Repetitorien der Elektrotechnik." Edited by A. Koenigswerther. Vol. I. Physikalische Grundlagen der Gleich- und Wechselstrohmtechnik. By A. Koenigswerther. 119 5¾x8¾-inch pages; 74 figures. Price in paper, 2.60 marks; bound, 3.20 marks. Vol. IV. Synchronmaschinen fuer Wechsel- und Drehstrom; ihre Wirkungsweise, Berechnung und Konstruktion. By W. Winkelmann. 148 5¾x8¾ pages; 79 figures. Price in paper, 3.40 marks; bound, 4.00 marks. Gebrueder Jaenecke, Osterstrasse, Hanover, Germany.

The Repertory of Electrotechnic to which these monographs belong comprises, or is planned to comprise, twelve volumes. The first of the series treats of the physical principles of continuous and alternating currents. It is intended for a text-book in technical schools. The subject is classified in six sections: Electrostatics, the electric circuit, magnetism, electro-magnetism, induction, and basic laws of the alternating current. Certain topics treated herein are introduced in an order rather out of the ordinary.

Volume IV, of the series, also before us, is concerned with synchronized machines for continuous and alternating currents. Two features which may be cited are a tendency to adopt a graphical method in handling problems and an appended list of citations to articles in technical journals.

We have received from the Massachusetts Bureau of Statistics of Labor a pamphlet forming a section of the annual report of the Bureau for 1905 and entitled "Industrial Opportunities Not Yet Utilized in Massachusetts." This publication contains a large amount of information relative to available land, help, water power, tax rebate, railroad facilities, vacant industrial establishments, etc., of 231 different towns in the State and should be of value and interest to those seeking locations for manufacturing plants. We believe the pamphlet may be obtained upon application to the Bureau at its offices in the State House, Boston.

Some of us become so interested in developing mechanical problems that we neglect the business problems of life, which are just as essential to commercial success as the mechanical ones.

At a meeting of the board of directors of the American Institute of Electrical Engineers on December 15, John W. Lieb, Jr., was appointed trustee to represent the Institute for a term of three years upon the board of trustees of the United Engineering Society, invested with the care and administration of the new United Engineering Building. Mr. Lieb at the same time was made a representative of the Institute on the building committee. He slceeeds Dr. Schuyle Skaats Wheeler, who, by reason of his recent election to the presidency of the Institute, resigns from these other bodies. The representation of the Institute therefore, after the annual meeting of the United Engineering Society in January, will consist of Messrs. Charles F. Scott, Bion J. Arnold and John W. Lieb, Jr., who are past presidents of the Institute in the order named. Work on the building is in active progress, and it is expected to lay the corner-stone early in the Spring.

The Seneca Falls Manufacturing Company, of Seneca Falls, N. Y., has revised prices on "Star" lathes, to take effect January 1, 1906; advancing prices 10 per cent. demand is constantly growing. Local on small sizes and 5 per cent. on large sizes of "Star" Lathes. The company has also advanced prices on its foot, hand and light power wood-working machinery.

The American Society of Heating and Ventilating Engineers will hold its twelfth annual meeting at the house of the American Association of Mechanical Engineers, 12 West Thirty-first street New York, January 16, 17 and 18.

The New York Association for Promoting the Interests of the Blind is endeavoring to educate and train blind persons for a greater degree of self support, and to this end needs funds to start and maintain an employment bureau, handicraft shops, etc. Particulars regarding the matter may be had by addressing the secretary, Miss Winifred Holt, 44 East 78th St., New York City.

Personal.

The editor would like the present address of Stephen P. Lathrop who was formerly manufacturer of the Lathrop Governor at Montclair, N. J.

John B. Freysinger, connected with Sargent & Company, New Haven, Conn., in various mechanical capacities in the manufacture of builders' hardware for over seventeen years, has resigned.

Robert L. Windholz, for a number of years manager of the machinery dedepartment of The E. A. Kinsey Co., Cincinnati, O. has resigned and will assume the position of sales manager of the Vandyck-Churchill Company, New York, with branches in Philadelphia, Pittsburg and New Haven.

R. S. Gott, for the past nine years foreman of the machine depot of the Goulds Power Pump Works, Seneca Falls, N. Y., recently resigned and was presented with a gold watch and chain, a silver water service, and a silver smoking set, as a token of the high esteem in which he was held by the company, foremen and workmen.

Dr. Richard Moldenke, Secretary of The American Foundrymen's Association, has become president of the Woolfsmouth Tool & Specialty Company Inc., 194 Broadway, which will manufacture and place upon the market an improved blacksmith tongs, which we understand have proven their value in Germany, and are to be introduced here.

A. Eugene Michel, who was for two years in the Engineering Department of the Diamond Chain Works, and at various other times in charge of the Testing Department of the Ewart Mfg. Co., and assistant manager of the Department of Publicity of The International Steam Pump Co., has become associated with The Geo. H. Gibson Co. Advertising Engineers, Park Row Bldg., New York City.

The many friends of Joseph S. Neave, of Cincinnati, will be interested to know that he has applied for and obtained the appointment of Superintendent of the Street Cleaning Department of that city. Mr. Neave was formerly one of the principal owners of the Bullock Electric Manufacturing Company. He is wealthy, and retired from business sometime ago when the company named was absorbed by the Allis-Chalmers Co. He is prompted to take the position referred to by public spirit and it is understood that he has an ambition to show what can be done by the application of straight business methods to the administration of this important department of the city's work. Those who know Mr. Neave will have little doubt of his success. He will not, of course, care to contemplate such a position as a vocation for life, but he will probably set a standard for the service, which will be more or less closely adhered to by his successors, as has been the case with those who have succeeded the late Colonel Waring in New York.

Business Items.

The Vandyck Churchill Co., New York, opened a branch office in the Farmers Bank building, Pittsburg, Pa., on January first.

T. B. Wood's Sons' Company, Chambersburg, Pa., on January first announced that they have succeeded the firm of T. B. Wood's Sons as manufacturing engineers, and under the same general management will continue to manufacture a complete line of modern and approved appliances for the transmission of power.

The David Bell Engineering Works has been incorporated with offices at Buffalo, N. Y. They have greatly increased their facilities for the manufacture of steam hammers and heavy machinery. The business was established in 1845. The following are the officers of the company: President H. T. Dunbar; vice president and general manager, David Bell; Secretary, F. C. Slee; Treasurer, George B. Bell.

The past few months have been exceptionally busy ones for the shops of the American Blower Company at Detroit, Michigan. They report that their books show outfits for heating and ventilating some 50 schools and other public buildings, between 30 and 40 manufacturing buildings, and a large number of dryers for brick, lumber and other materials. They are also doing a large business in the installation of mechanical draft plants.

As a large per cent of the purchases of the National Cash Register Company are made from eastern houses, they have established a purchasing department in New York City. Mr. H. F. Devens, their purchasing agent at Dayton, has assumed the duties of general purchasing agent with headquarters at rooms 1020-21-22, American Surety Building, 100 Broadway, New York City. Mr. Clifford R. Gardinor, assistant purchasing agent, was appointed purchasing agent, with headquarters at the factory, Dayton, Ohio.

The Carlyle Johnson Machine Co., Hartford, Conn., have shipped to the Whitinsville Spinning Ring Co., Whitinsville, Mass., an equipment for running their machinery direct from the line shaft employing 72 Johnson friction clutches. Another shipment of 40 clutches was to the Springfield Technical High School, Springfield, Mass. This consisted of cones mounted on Johnson friction clutches and used to run wood turning lathes in their manual training department also direct from line shafting. They advocate this method of driving machinery, due to the fact that by driving direct from one line shaft admits of placing machinery all in line under one shaft and does away with counter shafting, cross belting, extra pulleys, hangers, etc. It also saves considerable expense from the wear and tear on the belt, counter shaft, and pulleys, which are dispensed with, and in manual training departments also direct from line shafting, cross belting, extra pulleys, hangers, etc. They are now equipping the Stuyvesant High School East 23d Street, New York City, with 34 clutches to be used for driving wood turning lathes in their manual training department similar to the ones mentioned above.

New Catalogues.

Byer-Humrichouse Tool Co., Hagerstown, Md. Circular illustrating and describing double quick chucks and double offset lathe tool.

Northern Electrical Manufacturing Company, Madison, Wis. Bulletin No. 32, describing steel crane motors. Illustrated. 7x 10, pp. 16, paper.

Pennsylvania Metallic Packing Co., Diamond Bank Building, Pittsburg, Pa. Circular illustrating and describing metallic packing made by this concern.

The Bradford Durfee Textile School, Fall River, Mass. 1905-1906 Catalogue, giving courses of study and other information. Illustrated. 6x9, pp. 69, paper.

Crocker-Wheeler Co., Ampere, N. J. Bulletin No 62, describing and illustrating electric hoisting machinery, 7½x10, pp. 8.

Crosby Steam Gage & Valve Co., 16 Dey St., New York. Circular illustrating and describing the Crosby steam engine indicator.

Hancock Inspirator Company, 85 Liberty street, New York. Booklet describing Hancock globe, angle, 60-degree, cross and swing check valves. Illustrated. 4x6, pp. 23, paper.

Manufacturers.

The Standard Needle Company, Torrington, Conn., will erect a new plant.

The E. H. Clapp Company, Pembroke, Mass., intends adding a machine shop.

The Rockford (Ill.) Manufacturing Company is putting up a new foundry.

Spindler & Deringer, Jersey City, N. J., will erect a large new machine shop.

The Richmond (Va.) plant of the American Locomotive Company will be doubled.

The Trenton (N. J.) Brass & Foundry Company is putting up an addition to its plant.

The Cleveland (Ohio) Cliffs Iron Company is erecting a new plant in East Toledo, Ohio.

C. L. Hunt, San Bernardino, Cal., will rebuild his machine shop which recently burned.

The Louisville (Ky.) Tin & Stove Company will erect a new plant, to cost about $50,000.

The Coes Wrench Company, Worcester, Mass., is to build an addition to its knife shop.

The Baum Separator and Machine Company, Reading, Pa., is to build an addition to its plant.

The Torrington (Conn.) Electric Light Company is planning for an enlargement of its plant.

The plant of the Amercan Skein and Foundry Company, Ohio, Columbus, Ohio, will be enlarged.

Fire in the plant of the New Haven (Conn.) Clock Company resulted in a damage of $150,000.

The New York Central Railroad will soon let contracts for a new machine shop in Peoria, Ill.

The Excelsior Carbide & Gas Machine Company, Spokane, Wash., will erect a plant in Bellingham.

The Mt. Rock Foundry & Machine Company, Lewistown, Pa., is building a new foundry and machine shop.

The American Sewer Pipe Company, whose plant at Liverpool, Ohio, burned recently, has started to rebuild.

The plant of C. T. Roger Company, manufacturing machinists, Detroit, Mich., was burned; loss, $15,000.

Revised plans have been distributed for the factory to be erected for the Enterprise Wire Works, Baltimore, Md.

The Sioux City (Iowa) Traction Company is planning improvements in its power-house, to cost about $150,000.

Fire destroyed one of the power plants of the San Bernardino (Cal.) Gas & Electric Company; loss, $55,000.

The American Sewer Pipe Company, East Liverpool, O., was burned, December 21, causing a loss of over $75,000.

W. S. Notts & Co., fire-engine and leather goods manufacturers, Minneapolis, Minn., will build a large new factory.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., will erect an iron foundry, also a brass foundry.

The Stanley Works, New Britain, Conn., builders' hardware, are to build a new machine shop and a boiler-house.

The main building of the plant of the American Axe & Tool Company, Glassport, Pa., was burned; loss, $50,000.

The Iroquois Iron Company, Chicago, Ill., will erect two new blast furnaces and a coke plant, to cost about $2,000,000.

The Bethlehem Steel Company, South Bethlehem, Pa., will build an additional plant for the manufacture of structural steel.

It is reported that the Pennsylvania Railroad Company will locate a locomotive plant to employ 500 men, in Logansport, Ind.

The power house and main car shops of the Rio Grande Western Railroad at Salt Lake City, Utah, burned, resulting in a loss of over $150.

The Vandergrift-Conger Wrench Company is being formed in Shelbyville, Ind., to manufacture a wrench patented by T. F. Vandergrft.

Plans are being prepared for the factory which the American Can Company, of New York and elsewhere, will erect in Savannah, Ga.

Plans are being prepared for the buildings to be erected by the Yuba Consolidated Gold Fields Company for its machine shops in Marysville, Cal.

The Inner Harbor Gas and Electric Company, Long Beach, Cal., has recently reorganized with a capital of $200,000, and will erect a new gas plant.

A movement has been started in which L. L. Rose, of Endicott, N. Y., is interested, to construct a gas plant for Endicott and vicinity to cost about $75,000.

The French Manufacturing Company, Waterbury, Conn., recently organized, has let contract for a plant where it will manufacture tubing in small sizes.

Plans are being prepared for the erection of a plant for the Waterman Car, Wheel and Foundry Company, Houston, Tex., recently organized with a capital of $50,000.

A plant for the production of heavy steel castings is being erected in McKeesport, Pa. W L. Curry, of the McKeesport Tinplate Company, is interested in the new enterprise.

The Mutual Ice Manufacturing and Cold Storage Company, Charlestown, S. C., has increased its capital stock to $200,000 and will put an entire new plant on a larger scale.

Harry J. Dafoe, formerly principal of the Park School, Bay City, Mich. and others are forming a company to build marine and automobile engines. A factory site has been obtained.

The Ellis Adding Typewriter Company is equipping a factory at 16 and 18 Lawrence street, Newark, N. J., for the manufacture of a new combined adding machine and typewriter.

The Waterman Car Wheel & Foundry Company has been incorporated at Houston, Tex., with a capital of $50,000. W. H. Waterman, now with the Dickson Car Wheel Works, will manage the new plant.

A company to manufacture axles, gas engines and gas-engine mufflers is being formed at Chillicothe, O., with a capital of $50,000. F. A. Gramm, F. A. Arbenz, of the Board of Trade, and others are interested.

The Connecticut Computing Machine Company, New Haven, Conn., a new concern with an authorized capital of $600,000, has secured a factory building, which will be equipped for the manufacture of its adding machines.

The Hobbs Manufacturing Company, to do a general manufacturing business in tin and galvanized steel, machine tools, etc., has been incorporated at New Orleans, La.; capital, $100,000. Peter Jung, of the Crescent Bed Company, is president.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted.—A good second-hand slotting machine 18" or 20" stroke. Send full particulars. Slotter, AMERICAN MACHINIST office.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Fine machinery, tools and dies built to order; experimental work a specialty. Northwestern Machine & Tool Co., 614 Union Trust Bldg., Detoit, Mich.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

American age 40, extensive acquaintance with the trade desires to become eastern representative for reputable manufacturer. Steam engines, boiers, pumps, air compressors, electrical or other machinery. Address Box 13, AMERICAN MACHINIST.

Tool Catalogue No 22, 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

Law of Foreign Business Corporations doing business in the state of New York, by John Henry Mann. Trading and manufacturing corporations of other states located in New York will find this book invaluable. Firms contemplating incorporation should study it. Price $3.50 delivered. Banks & Company, Law Book Publishers, Albany, N. Y.

Machinery.—A machinery company including in its organization a sales-manager of wide experience and recognized ability, and a mechanical engineer thoroughly acquainted with the actual needs and practice of the mills, fitting shops, and machine shops in the Pittsburg District, desires the exclusive right to sell in this territory a first class line of machinery and tools. Correspondence is solicited from concerns whose goods are already advertised and who desire actve personal representatives. E. E. Hunt & Co., 6414 Center Ave., E. E., Pittsburg, Pa.

For Sale.

For Sale—10-ton crane, 40 ft. span, rope drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co., Burlington, Iowa.

Sub-let—Brick warehouse, Bridgeport, Conn.; two stories and high basement, with elevator; 75x150feet, on lot 100x150 feet; directly opposite freight station, N. Y., N. H. & H. R. R. Present lease expires April, 1907. Address R. H. W., P. O. Box 1358, New York.

For sale.—Well established machinery manufacturing business. Patented machinery; well established with the trade. Competition very limited. Market very large in U. S. and foreign countries. Good profits. Opportunity to acquire paying business. Investigation and correspondence invited. Address H. R. Irwin, Sta. "B"., Cincinnati, Ohio.

For sale—A machine shop established 12 years. Lathes, drills, grinders, etc. Patterns for 3, 6, 15 and 25 horse power gasoline engines. Automobile engine patterns for 6, 12 and 16 horse power. Several other patterns, and engines in stock at present. Also repair trade paying big profits in Canadian town of 45,000 inhabitants. Must be sold at once on account of ill health of proprietor. Price about $3,000. Box 12, AMERICAN MACHINIST.

Brass foundry, Bridgeport, Conn., opposite freight station and within 500 feet of waterfront. Property consists of 113.4 square rods. Main building, 60x200 feet, and equipped with crucible (21) furnaces, trolleys, etc.; fireproof pattern safe, coreroom and supply sheds, stamp-mill and well yielding 200 gallons per minute. Location also valuable as warehouse. Address R. H. W., P. O. Box. 1358, New York.

Business Opportunities.

Practical, experienced American engineer contemplating foreign trip solicits correspondence with parties desiring either temporary or permanent repesentaton in Europe. Manufacturing, sales, inspection, investigation reports. Address Box 10, AMERICAN MACHINIST.

Safe opportunity for a small investment. Manufacturing company now earning 30% net, with contracts for work sufficient to rush factory for several years, must increase facilities and will sell a few shares of capital stock for the same price all present stockholders have paid ($100. per share.) No salaries are paid to officers—All stock issued represents cash paid in (no water.) Manager

has been successful superintendent for others and has his own money invested in this enterprise. Business on hand for 1906, $60,000.00. Estimated profit 1906, $20,000.00. Net assets (over all liabilities) $15,000. Factory located 20 minutes from New York City postoffice. Address Box 5, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Classification indicates present address of advertiser, nothing else.

Situations Wanted.

CANADA.

Position as foreman and designer on jigs, compound dies, experimental, etc.; 20 years' experience; references. Box 943, AM. MACH.

CONNECTICUT.

Position assistant superintendent or chief draftsman 15 years experience designing and manufacturing valves, hydrants and fittings. Box 3, AMERICAN MACHINIST.

ILLINOIS.

A1 machinist and toolmaker, 29 years of age, technical graduate from Germany, desires to change. Has 11 years' shop and 3 years' drawing room experience. Will take position as foreman, with concern doing light and interchangeable work. Box 16, AMERICAN MACHINIST.

NEW JERSEY.

Position wanted by experienced mechanical draftsman.. Box 909, AMER. MACHINIST.

NEW YORK.

Mechanical draftsman wishes to change. Box 941, care AMERICAN MACHINIST.

A1 mechanic desires position to get acquainted with linotype machines. Box 15, AMERICAN MACHINIST.

As superintendent or manager, expert mechanic wishes position after January 1. Box 962, AMERICAN MACHINIST.

Machine shop foreman, 12 years, age 38, thorough, practical and reliable, will engage at once. Box 961, AMERICAN MACHINIST.

Mechanical draftsman, graduate; several years' experience as draftsman and designer. Open for engagement. Box 9, AMERICAN MACHINIST.

Designer, graduate M. E. (age 30); shop 2 years, 9 years office, special and small machinery, apparatus, jigs, fixtures and experimental work; practical and inventive man, hustler; location immaterial. Box 945, A. M.

OHIO.

Works manager for manufacturing plant; know, the automobile business from A to Z. Box 955, AMERICAN MACHINIST.

Wanted—Position as draftsman or foreman; practical machinist; graduate mechanical course; International Correspondence Schools; aged 28. Address G. C. D. care AMERICAN MACHINIST.

PENNSYLVANIA.

Architectural and civil engineer with extensive experience in the design of industrial buildings is open for engagement with large manufacturer or with a mechanical engineer making a specialty of such work. Address 14, AMERICAN MACHINIST.

Superintendent or foreman open for position Feb. 1st. Have a long experience in both light and heavy interchangeable work on tools steam and gas engines up to 800 horse power. Inventive, active and of good habits. Box 1. AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Several die makers, also tool makers for fixtures and gauge work. Ross Rifle Co., Quebec, Canada.

CONNECTICUT.

Wanted—First class die sinkers and drop forgers. Kilborn & Bishop Co., New Haven, Conn.

Wanted—Foreman for machine department manufacturing automobiles; experience in this line not essential, but must be a first-class man able to produce results; prefer a married man not over thirty-five years of age; all correspondence confidential. Address Box 940, AMERICAN MACHINIST.

ILLINOIS.

Draftsman.—We have positions now open for draftsmen. Call or address Western Electric Co., Chicago, Ill.

Mechanical draftsman, with experience on adding machines, cash registers or typewriters preferred. Permanent position; salary about $125 with good opportunity for advancement. Engineering Agency, Chicago, Ill.

MARYLAND.

Wanted—To meet our constantly increasing requirements, we invite applications from first class toolmakers, machinists, Jones & Lamson operators, Gisholt machine operaters, milling machines, bench hands and pattern makers. Address Box 6P, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Operators for Gleason planers and gear cutting machines, also turret lathe men. Box 956, AMERICAN MACHINIST.

Machinists Wanted—We are increasing our force and need good all-round men for the building of special automactic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

Wanted—A first class mechanical draftsman, one with experience on automatic machines (screw machines preferred.) Must be a man with original ideas to develop new machines. Give full experience, wages expected and state if married or single; factory near Boston. All answers will be considered strictly confidential. Box 8, AMERICAN MACHINIST.

MICHIGAN.

Wanted—General foreman to take active charge of iron and steel working plant; good opportunity for right man. Box 530, Lansing, Mich.

Gear Planer Operator.—Wanted—Two operators experienced in running Gleason full automatic 36 in. gear planers; steady work; best pay. Industral Works, Bay City, Mich.

Wanted—3 or 4 first-class, A1 automatic screw machine hands; to experienced men will guarantee steady position and highest rate of wages. Answer, with reference, to Box 85, Detroit, Mich.

NEW JERSEY.

Wanted—A first-class mechanical draftsman; state experience and salary wanted. Box 881, AMERICAN MACHINIST.

First-class mechanical draftsmen wanted at once; must have experience in mill construction and power plant design; state age and salary expected. Box 958, AMER. MACH.

We are increasing our works and want applications for machinists; in reply give details of experience, age and wages expected. The Edison Portland Cement Co., Stewartsville, N. J.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

NEW YORK.

Wanted—Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

Mechanics—Several for small accurate brass and steel work. State experience and wages. Box 4, AMERICAN MACHINIST.

Wanted—First-class die and tool maker, as working foreman of machine and tool department. The Pritchard-Strong Co., Rochester, N. Y.

Wanted—Several first-class toolmakers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7, Syracuse, N. Y.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 859, AMER. MACHINIST.

Wanted—Several A1 draftsmen; only those with 3 or more years' practical experience need apply. Engineer in Charge, Drafting Dept., General Electric Company, Schenectady, N. Y.

Wanted—Experienced draftsmen, first-class machinists, toolmakers, and gauge makers; give detailed experience, references, age and wages expected. Remington Arms Company, Ilion, N. Y.

Wanted—Several mechanical draftsmen on structural details of electrical work. Good opportunities and steady positions. State age, experience and salary. Box 7, AMERICAN MACHINIST.

Wanted Immediately—Experienced machine tool salesman for the Philadelphia territory. State age and experence and give reference. Vandyck Churchill Company, The Bourse, Philadelphia.

Machinist Wanted.—Familiar with the setting and sharpening of stamping dies, capable of takng charge of metal stamping presses. Reply stating wages expected. W. M. Crane Co., Factory, Peekskill, N. Y.

Wanted—Two first-class toolmakers on combination dies and drawing dies for sheet copper, brass and sheet iron. Advise as to experience, references and wages expected. Box 929, AMERICAN MACHINIST.

Wanted—Man of practical experience in the manufacture of small, interchangeable parts; gun work preferred; qualified to estimate on piece prices; must have good executive ability and judgment; state experience and salary expected. Box 926, AMER. MACH.

Wanted—Man with technical training as draftsman and engineer, with experience in the design of special machine tools for economical production of interchangeable machine parts in large quantity; person with practical experience as a machinist preferred. Box 953, AMERICAN MACHINIST.

Draftsman to make working drawings from incomplete drawings, patterns, castings and finished parts; thoroughness and accuracy are essential; only applicants who desire permanent position will be considered; experience on pump or engine work desirable; location New York City; state experience and pay expected; give references. Address Box 951, AMERICAN MACHINIST.

OHIO.

Wanted—Machinist, capable of taking charge of machine shop making bakers' and chemists' mixers. A splendid opportunity for good, energetic man. Address Box 2, AMERICAN MACHINIST.

Wanted—Foreman to take charge of about 20 vise hands in Cincinnati; must be well recommended, and had charge of vise work in tool shop. Address, with references, The Cincinnati Milling Machine Co., Cincinnati, O.

Wanted—A mechanical draftsman, experienced in steam engine designing; must be a technical graduate, capable of doing the routine figuring of the drafting room; state age, experience, education and salary expected. Address The Hooven, Owens, Rentschler Co., Hamilton, O.

Wanted—A good designer who has had practical machine-shop experience as well as technical education, to work at the designing of new special tools and machines; some originality and inventive ability required; state age, experience and salary expected; also name references. Address Box 949, AMER. MACH.

PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMERICAN MACHINIST.

Wanted—First class floor hands with experience in assembling machine tools. Apply Stoever Foundry & Manufacturing Co., Myerstown, Pa.

Wanted—A number of A1 tool, die and instrument makers. Also wood pattern makers. Address Employment Department, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa.

A number of mechanical draftsmen; those with experience in electrical apparatus, generators or motors preferred; only first-class men need apply. Address Chief Draftsman, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa. P. O. Box 911.

WEST VIRGINIA.

Wanted—Good lathe and vise hands; good wages; no labor trouble; increase of force. Answer, stating age and wages expected, Box 952, AMERICAN MACHINIST.

WISCONSIN.

A working foreman familar with gas engine work, to take charge of erecting floor. Address, with references and salary expected, Box 946, AMERICAN MACHINIST.

To meet our constantly increasing requirements, we invite applications from first-class machinists and bench hands. Those familiar with engine work preferred. Address with references Globe Iron Works Company, Menomonie, Wisconsin.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen, with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMER. MACHINIST.

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Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Brass and Bronze
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.
U. S. Foundry & Sales Co., South Norwalk, Conn.
Yale & Towne Mfg. Co., Stamford, Conn.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Cullman Wheel Co., Chicago, Ill.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link-Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

Chucking Machines *Continued*
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Ceveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compounds, Boiler
Advance Mfg. Co., Kalamazoo, Mich.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.

Heavy Gun Making at the South Boston Iron Works.

BY WM. P. HUNT.

The South Boston Iron Company was incorporated in 1827 and from that time until 1860 was one of four establishments upon which the United States government relied for the manufacture of ordnance and ordnance stores, and for experimental work in the development of improvements in ordnance construction. These four establishments—one at Richmond, one at Pittsburg, one at West Point, and one at South Boston—were regularly kept supplied with Government orders to a moderate extent. After 1860, when the Civil War was upon us, the works had orders for more than they could promptly supply, and the Government was forced to call upon other establishments to fit up for the construction of ordnance and ordnance stores.

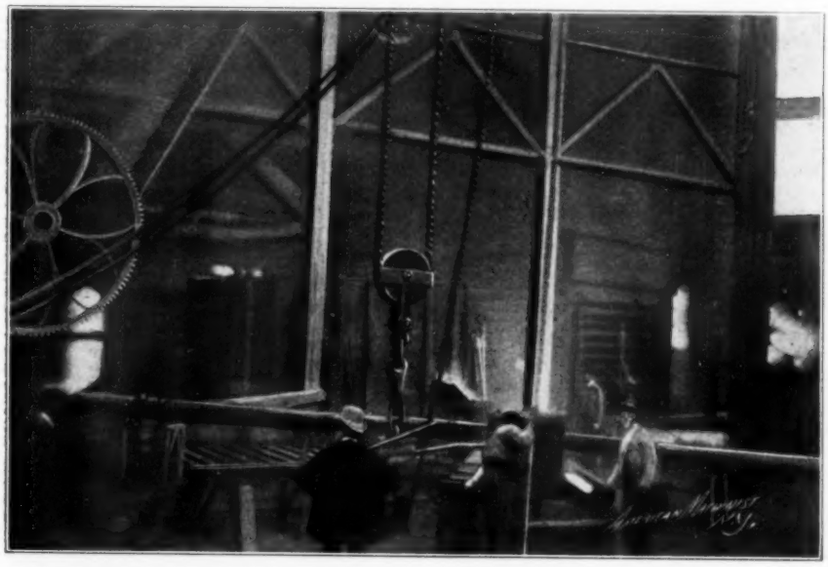


FIG. 1. CASTING A 50 TON RIFLE.

During the war, the Government had only gray-iron cannon and bronze field pieces, with the exception of the Parrott gun, which was a gray-iron rifle with the breech reinforced by a wrought-iron band. After the war the Government took up experimental work with a view to improving upon such gray-iron guns as it had heretofore used. At that time steel guns were being made in Europe, and the question was how we could improve what we had, until we had facilities in this country for producing steel. Another question was, had the steel guns made by Krupp and Armstrong shown greater strength and durability than could be obtained from such gray-iron guns as had proved their serviceability during the war?

Up to the close of the war the ordnance used by the Government was as follows: Bronze field pieces, 6 to 12 pounds; Parrott field pieces (rifles), small caliber, 3 or 4 inches; Army, Rodman gray-iron guns, 8, 10, 12, 15 (experimental), 20 inches; Navy, 9-, 11- and 15-inch Dahlgren guns, 6-, 8- and 10-inch Parrott rifles.

The Rodman gun was wholly of gray iron, but cooled in casting from the bore—that is, a tube through which water was circulated was placed in the mold and the molten iron poured around this tube. When the casting was cool the tube was drawn out, leaving the casting, not only with a core in it, but a casting that was cooled from the center, which operated to shrink the exterior around the center and so add to the resistance to the explosive force when the gun was fired.

The Dahlgren gun was also wholly of gray iron, but different from the Rodman, in that it was cast solid and so cooled from the exterior and the casting was bored out. Both were smooth-bore guns, and each was named from the officer who designed it—Rodman of the army and Dahlgren of the navy. The 11-inch Dahlgren guns carried by the "Monitor" in her fight with the "Merrimac" and the guns of the same type which sunk the "Alabama" were made at the South Boston works.

The Dahlgren gun was designed about 1840 and the Rodman some fifteen years later. Hundreds of these heavy Rodman and Dahlgren guns were made during the Civil War (not including the 20-inch Rodman, which was experimental, only a few having been made at Pittsburg).

After the close of the war many of the 10-inch Rodmans and the 11-inch Dahlgrens were converted into rifles, by fitting wrought-iron tubes into the bore and reducing the caliber from 10 to 8 inches. Later on it was thought best to experiment with gray-iron rifles of greater length and weight than any of the guns used during the war. Finally, the South Boston Iron Company contracted with the Government for several gray-iron rifles of over 50 tons finished weight each. This was about 1885. These guns were fired at the Sandy Hook proving grounds, and all have been fired more than one hundred rounds each with charges of 265 pounds of powder and 800 pounds projectile, and are still serviceable.

Since that time the quality of steel has been improved, and is now produced in this country at comparatively moderate cost. All United States ordnance is now made of steel forgings, assembled by shrinking bands over a tube, at the Washington navy yard, and at the Government arsenal at Watervliet.

FIG. 2. A GREY IRON RIFLE.

The accompanying illustrations refer to the 50-ton rifles made at the South Boston Iron Works in 1885. Fig. 1 shows the interior of the foundry at the time of pouring. The foundry was equipped with three reverberatory furnaces, each capable of melting 40 tons of metal. The mold for the casting was in an iron flask, which was set in a pit some 40 feet deep. The upper end of the flask appears in the foreground. Runners from each of the furnaces lead to this flask and of course all were tapped out at once. The white spots

in the half-tones show the molten metal or the reflection from it.

Fig. 2 shows the casting after the flask has been removed. The imposing hero on top the gun is *not* General Grant.

Fig. 3 is the result of a disastrous attempt to cast one of these guns. After the casting had been poured and everything was seemingly satisfactory, the iron flask at the bottom of the pit broke apart and all the metal of course found its way to the bottom of the pit. Fortunately, the visitors who witnessed the casting had all left before the break, but the explosion or break resulted in setting the building on fire and a damage of some $8,000.

When this mass in the pit had cooled, it was a problem to take it out, for the pit was needed for other castings. The mass was of solid iron 11 feet in diameter and 8 feet high, weighing, with the flask, some 140 tons. As the pit was lined with brick, and the molten mass came in direct contact with it, the force required to lift it was more than the weight, as it had to be broken from the rough surface and uneven diameter of the pit. We tapped some twenty holes in the top of the mass and screwed in steel rods, and with hydraulic pressure, pulled out the ugly customer. It required some 700 tons pull to start it.

Echoes From the Oil Country—Getting the Good Will of a Director as Told by a Manager.

When a lot of men get together who are interested in things mechanical, and who are experts in some line or other of practical work, the conversation does not lag. With this bunch various things had been receiving attention, when one man turned to me with, "I had an offer to go to your town once, and if I had not known as much as I did about the man who made it I should have gone. As it was I knew that we would not get along together, although I liked him personally. You knew M——, did you not? Yes, I did not think you could live in the same place and not know him. I had a very funny experience with him once. It comes under the head of shop management. Perhaps you know he was interested in other shops besides those in his own city. He was one of the directors of the S—— shops.

"The general manager there was one of the finest, smoothest men you ever saw, but he was not a good man to enforce discipline and things got bad in that line. He was the very best kind of a man to meet a board of directors, and could not be beaten in making it pleasant for a possible purchaser, but when it came to getting the work out it was different. He knew that himself, and so to even things up he began looking around for the ugliest, bluntest, and most hard-hearted man he could find, and so picked me out."

None of the listeners filed any objections to the opinion that R—— thus expressed of himself. He surely looked as though he would stick tight if he once took hold.

"I came before the board of directors and was asked if I would take hold of the shop," he continued, "and I told them I would if I was given full charge of the hiring and firing, and of fixing the rates of wages, but not otherwise. This was agreed to, and I took charge. One of the first moves I made was to put a high board fence around the whole place, and to require everyone to come in and go out at the one place where they could be kept track of.

"Before I went there things were run in a free-and-eacy, good-natured sort of a way. The only one who knew when a man came in or when he went out was his foreman, and each foreman kept the time for his own men.

"The foundry was the worst proposition of the lot. There is not any doubt but what the foreman there had a regular graft. He carried a cheap watch, and if a man applied for work he would offer to sell the watch, which may have been worth a dollar, for perhaps fifteen dollars. The fellow would likely say 'I haven't any money to buy the watch.' He would be told that if he was willing to work he could have a job and give a dollar a week out of his pay until the watch was paid for. After the watch was paid for he would be out of a job, and someone else would be given a chance to get a bargain.

"I found a man that I thought could run that foundry. He was recommended to me to be a first-class man as long as he was sober and as good as lots of other men when he was drunk. He was a great big fellow, an Irishman, and had been a fighter in his time—a regular pugilist. I told him that he was to have full charge in the foundry and that he was not to take any orders from anyone but me, but that I would expect him to get out the work.

"Some time after I had the fence done some of the directors came out to the shop, and the first thing they ran into was the fence. They had been used to dropping into the shop from any direction, and this was something different. While most of them got onto the walk and started for

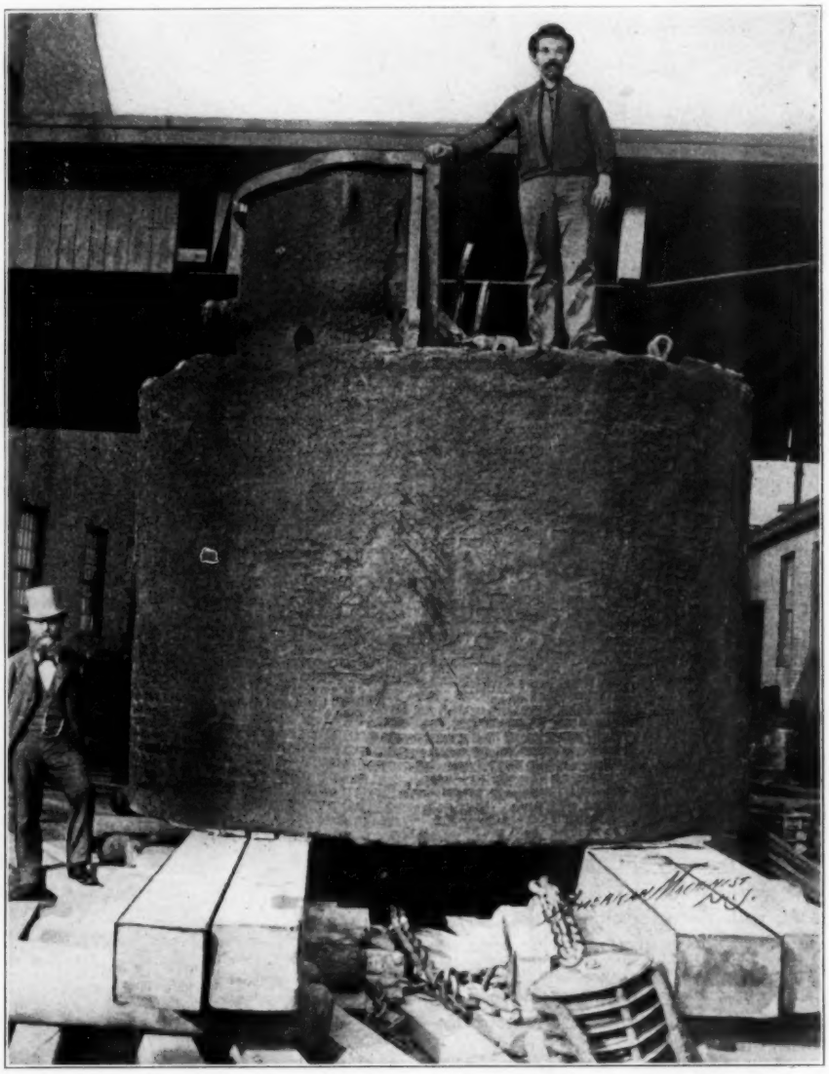


FIG. 3. A FAILURE.

the entrance, M—— climbed over the railroad gate and made for the foundry. Of course I did not know anything about this at the time.

"A boy came into the drafting room where I was busy and said, 'The foundry boss wants to know what to do to a man who would come into his shop and interfere with the men.' 'You tell him,' says I, 'that if anyone comes in and does that, to take him by the coat collar and the seat of the plants and throw him out of the window.' I thought he was big enough, and knew that he was ugly enough to do it if he got a chance.

"In a little while I got word that I was wanted in the office and went over. As I went in I saw a couple of the directors sitting there. They were laughing and seemed to be awfully tickled about something. 'Did someone want to see me?' I asked. As I spoke I looked around and there, back of the door, stood M—— with two boys trying to get some of the dirt from his clothes. He was literally dirt from head to foot.

"'I sent for you'—(at this point the reader will have to excuse me from following too literally the language used either by the director or by the manager. It does not look a bit better in print than it sounds in practice. Some people have so neglected the study of the language of their nativity that they have no really suitable vocabulary in which to express the strong emotions of the soul. At such times certain well-known but inelegant expressions are used. These serve a useful purpose in conveying to the hearers the lack of good breeding of the user, or else unveil the weakness of the mind that has been reduced to a state bordering on idiocy by some exasperating occurrence.—The listener)—'to tell you that I have discharged that big ugly brute that you put in charge at the foundry.'

"'And I want to tell you,' says I, 'that you can't discharge anyone around here. I am the only one that can do that.'

"'I'll show you whether I can or not. I'll let you understand that I am one of the directors here, and I have told that fellow that he is fired.'

"'And I tell you right here that I will do the firing if there is any to be done. If that man or any other one has been breaking any of my rules I will attend to him without any help from you. All you have to do is to let me know what he has done.'

"'Just look at me and see what he has done. He took me by the neck and threw me out of the foundry door onto a pile of dirt. Look at my clothes.'

"Said I, 'if that man, after the orders I sent him, threw you out of the *door* I certainly shall discharge him for disobedience. I distinctly told him to throw you out of the window, and when I tell a man to do a thing around here he is either going to do it or get out.'

(Let your imagination work on the embellishments of language as noted before.)

"'Do you mean to stand there before me and say that you told him to throw me out.' (It was fortissimo-ascendio-forocio.)

"'I can't just say,' says I, 'that I told him to throw *you* out, but I did tell him that if anyone came around and went to interfering with the men, to throw *him* out. What were you doing in the foundry, anyhow?'

"'I saw a man that was not doing his work right, and was explaining things to him (M——'s ways of explaining things to his employees necessitated a very free use of words of euphony, or at least of words that were used only for their sound, and not for any idea which they could help to convey), when this big gorilla of a thing came charging down on me, and out I went.'

"'Well, I am sorry. I am, indeed. To think that after all my hard work here is a man who dares to disobey orders. He should certainly have thrown you out of the window. Why, he didn't even try to do it. I guess there is nothing for it, but for me to discharge him, for the men must understand that what I say goes. I did have some hopes that he would make a good man, too, said I.' The boys were brushing away at M——.

"'How much do you pay that fellow?' he asked.

"'Five dollars a day,' I answered.

"'Make it six. Make it six. He is worth it, and I want to tell you that you have something here that we never had before, and that is discipline. You are all right and so is that other fellow. I'm going out and take another look at him.'

"Said I, 'you better be careful how you look. If he finds you are interfering with his work or with the men he will surely throw you out of the window the next time. I really don't understand how he failed to do it the other time. I hold him strictly responsible for all the work of the foundry, and for every man in it, and I expect him to run things. Any orders I have for the foundry I will give to him, and as sure as there is sand in it, as soon as I find that he has not the nerve to run his own place out he goes, and when he goes he goes for good.'

"By this time M—— was on his way to the foundry, and I was following along. You know that M—— was a big man. He must have been nearly six feet tall, and he was Irish too. The foundry foreman was about six foot three, so you can see that they made a big pair. It had probably surprised M—— to find a man big enough and bold enough even to throw him out of the door.

"My man evidently expected trouble as he saw M—— coming toward him, and I could see that he was ready for it by the way he squared himself up. It was a fine sight to see. Both great, big, strong, hearty men, bold and aggressive. For a moment they faced each other, then M—— reached out his hand. 'My friend,' said he, 'I want to shake hands with you. You're all right. I have just had your wages raised.'

"I agreed to stay with that company a year and get things going, and talk of work! Say! I worked day and night and thirty-six Sundays out of the forty-eight weeks that I was there. Then I got tired. Things were running all right, and just as well as they would be if I stayed the full year, and I wanted to rest a bit. After being there eleven months I left and went East where I could make more money with less work."

The talk drifted away from the S—— works and left several questions unasked.

W. OSBORNE.

FIG. 4. GUN MAKING AT SOUTH BOSTON IRON WORKS.

In the qualifications necessary for foremanship it is sometimes argued that a man should learn to obey before he undertakes to command. What is really more to the point than this is, that he should learn to master himself before aspiring to master others.

The United States Arsenal at Frankford—IV.

BY F. A. STANLEY.

Two very important departments at Frankford are the chemical laboratory, where smokeless powder and other high explosives are tested, and the proofhouse, where tests are made of ammunition, fuses, primers, etc. The laboratory is illustrated by Figs. 48 and 49; the proofhouse by Figs. 50 and 51.

AMMUNITION TESTS.

The operations in the latter department include the testing daily of a certain amount of small-arms ammunition from each loading machine, ten cartridges from each machine being fired each day in accuracy tests and ten from each machine every morning and afternoon in tests for velocity. Other small-arms ammunition tests determine the powder pressure in the rifle chamber, the penetration of the bullet, the strength of the case, etc.

In proving the accuracy of the cartridges the shots are fired from a rifle clamped in a fixed holder and aimed at a target at 500 yards, the grouping of the shots showing whether the ammunition is up to standard in this respect. The velocity tests are made with the aid of another fixture, Fig. 51, which keeps the rifle trained on a wire screen supported three feet from the muzzle, and on a steel disk 100 feet beyond that; the interval of time elapsing between the breaking of the wire and the impact of the bullet upon the disk being gaged by means of a Boulengé chronograph. In this instrument a steel rod carrying a soft sleeve is suspended by an electro-magnet which releases the rod when the bullet interrupts the circuit by breaking the wire in front of the muzzle; and, upon the bullet striking the disk 100 feet away, a knife, past which the rod falls, is released and cuts a fine nick in the soft sleeve enveloping the rod.

A gage point has already been established on the soft metal sleeve, just prior to the firing of the shot, by simultaneously releasing the suspended rod and the knife-tripping mechanism, and the distance between the two very minute nicks in the sleeve now forms an accurate measure for the determination of the time taken by the bullet in covering the 100 feet between the wire and disk. The distance between the two knife marks is measured by a special caliper and by referring to a chart or table, which has been carefully worked out for the purpose, the initial velocity (actually the velocity at 53 feet from the muzzle) in feet per second is found at once. The data obtained during these tests morning and afternoon, are utilized immediately in regulating the powder charges in the loading machines; and so carefully are the operations conducted that it is possible to regulate the charge to within one-tenth of a grain, which means holding the initial velocity to within seven feet of the standard, which is 2,300 feet per second.

Besides the chronograph, the proofhouse is equipped with the Schultz chronoscope and other instruments for measuring minute intervals of time, and some of this scientific apparatus will be noticed in the view shown in Fig. 50. The device for determining the powder pressure is shown to the right of the rifle in Fig. 51, and consists of a strong barrel of standard bore, provided with a heavy block at the rear end which is attached to the bench plate. The block is chambered to receive the cartridge and carries firing mechanism at the rear. A hole through the top is adapted to receive a small copper cylinder or plug of a certain length and having a cross-section of known area, and over the seat for the plug is an adjustable block to resist the upward movement of this copper test piece when the cartridge is fired. After the cartridge is placed in its chamber the latter is closed with a gas check, and when the cartridge is fired the pressure compresses the copper plug against its abutment and shortens it somewhat. Upon being measured in a micrometer the exact amount by which its length has been reduced is discovered, and a table is then referred to which gives the pressure per square inch required to accomplish this result.

In testing each new lot of metal for cartridge cases upon its arrival at the arsenal, ten cases are made up at once, loaded and fired and then reloaded and fired again until each case has been used for twenty shots. If no defects appear in the shells during the trial the metal is considered satisfactory.

When jacketed bullets came into use in our service, extensive tests were conducted to determine the form of bullet and the jacket material which should best fulfil the requirements as to accuracy, penetration, non-stripping of the jacket, etc. Copper, german silver and other jackets were tried, with smooth surfaces; also with cannelured bodies for lubricant, and with various degrees of sharpness and curvature in the point of the bullet. In tests to show resistance of the jacket to stripping, bullets were fired into sawdust or into water tanks from which they were recovered for purposes of examination. Eventually, cupro-nickel was adopted for the jacket material, and while cannelured bullets were used for some time, more recent tests at the proofhouse proved the superiority of the smooth, sharp-pointed bullet, which was consequently adopted for the new ammunition.

Other tests, conducted at the proofhouse, have involved the firing of thousand of rounds from different rifle barrels to determine the destructive effect of various classes of smokeless powder and different jacketing material upon the rifling of the bore, the barrels of the rifles used in these tests being cut open longitudinally after the discharge of several thousand shots through each to permit of careful inspection and comparison of one with another.

ARTILLERY CARTRIDGE-CASE WORK.

The three views, Figs. 52, 53 and 54, illustrate some of the operations of the artillery-cartridge department, which manufactures the brass cases for ammunition for field and siege guns and for coast artillery of caliber up to 6 inch. In the presses in Fig. 52 some 3-inch cases for field-gun ammunition are being drawn up, the four presses used on this work being belted from a motor-driven line-shaft. The round blank for the 3-inch case is 5¾ inches diameter by .324 inch thick. The big press at the end of the group forms the cup, and five successive drawing operations in the other machines elongate the shell or tube to the necessary length for trimming and heading. After each draw the work is annealed in a room adjoining the draw-press department, and after the final draw and anneal the cases, then about 10½ inches long, go to another room, Fig. 53, where the ends are trimmed on a mandrel and the heads formed, the latter being done under powerful hydraulic presses.

For heading, a thin die, shown in front of the operator in the foreground, is used. The face of this die is counterbored to the proper depth and diameter for the head, and after the operator has placed a plain case in position, the die and work are passed over to the man at the heavy hydraulic press, who places it on another die in which there is a central punch of the right diameter to fill the work and steady it while the ram is operated. Upon the head being pressed out and the ram returned, the die and work go back to the first operator, who inverts them under the lighter press and forces the case out of the die. Following heading operations the cases are placed in Potter & Johnson turret lathes where the heads are turned off to size and faced to proper thickness; also a seat for the primer is rough bored through the head to 0.375-inch diameter, this hole being later enlarged to 0.440 inch by a mandrel which is forced through to compress and stiffen the metal about the pocket, and so prevent the latter from enlarging when the cartridge is fired. The case is tapered slightly throughout its length, so that it shall not stick in the gun after being discharged, and is then ready for priming.

The 3,000-ton hydraulic press and the six-plunger pump in Fig. 54 are employed for heading the larger sizes of cases up to 6-inch, the latter requiring about 2,200 tons pressure. The method of holding the heading die in place is shown here, and also the arrangement for sliding the die block in and out of the press when putting in or removing work. The 6-inch

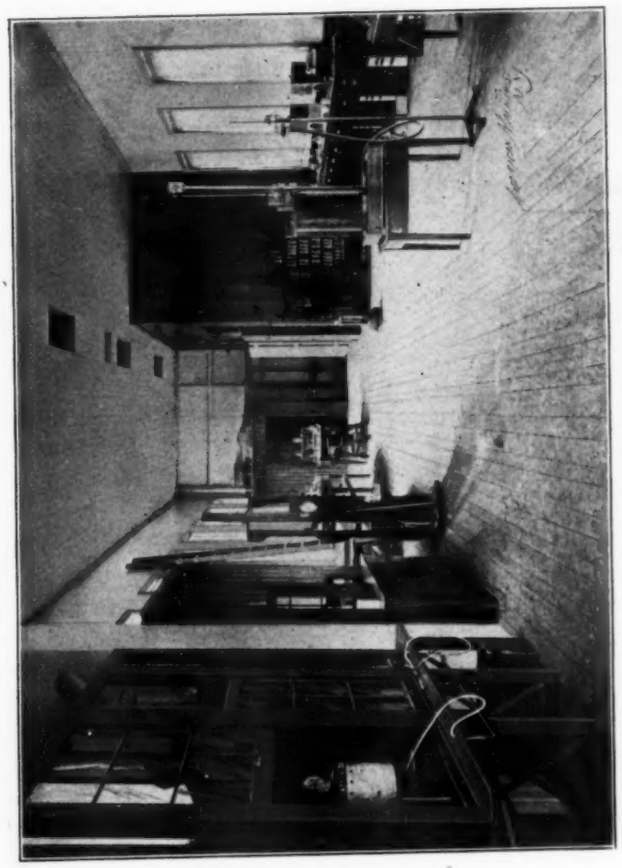


FIG. 49. TESTING DEPARTMENT CHEMICAL LABORATORY.

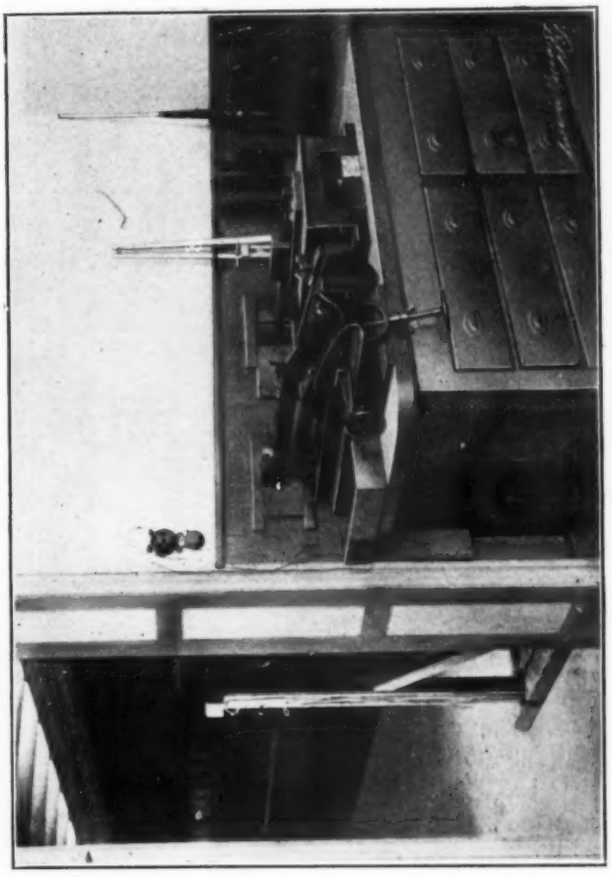


FIG. 51. INTERIOR OF PROOF HOUSE SHOWING GUN IN FIRING REST.

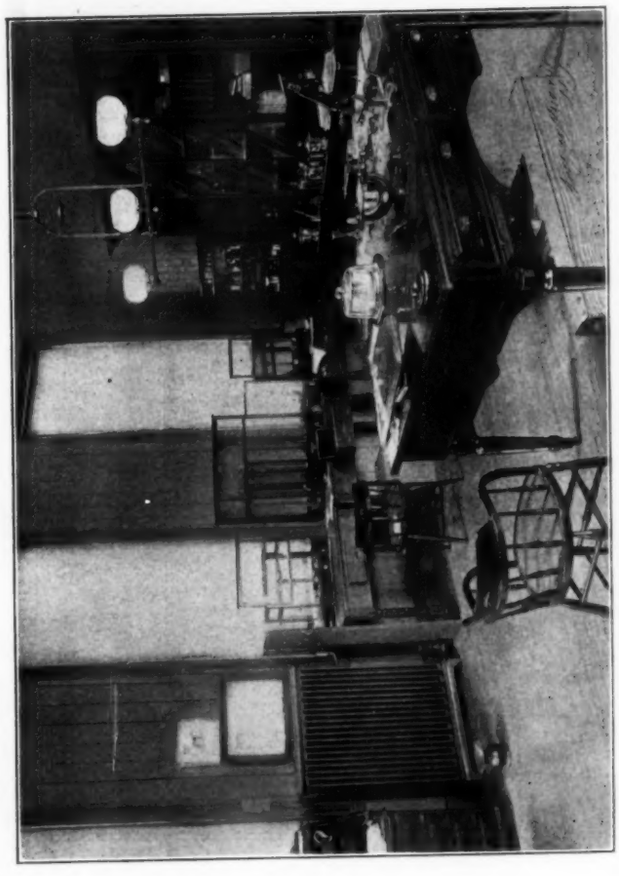


FIG. 48. CHEMICAL LABORATORY OFFICE.

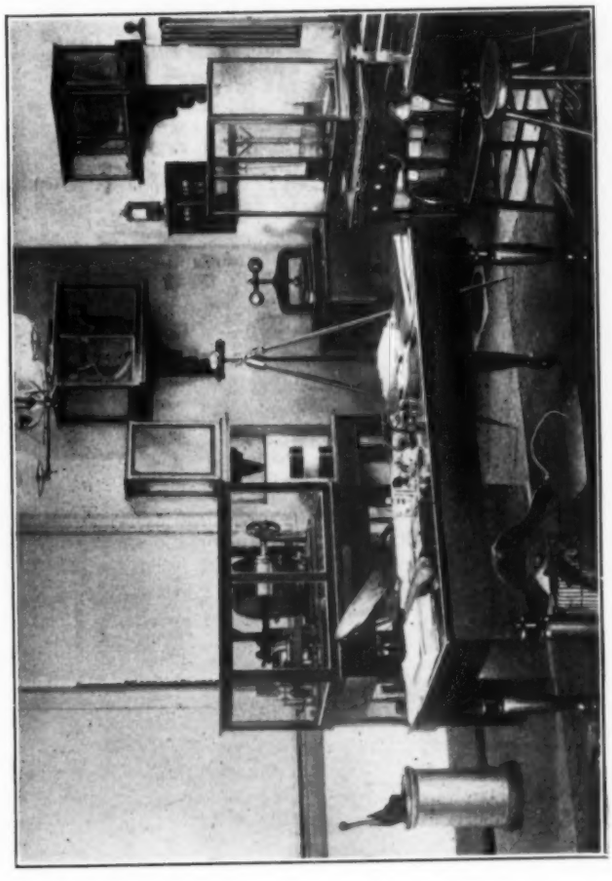


FIG. 50. INTERIOR OF PROOF HOUSE SHOWING INSTRUMENTS.

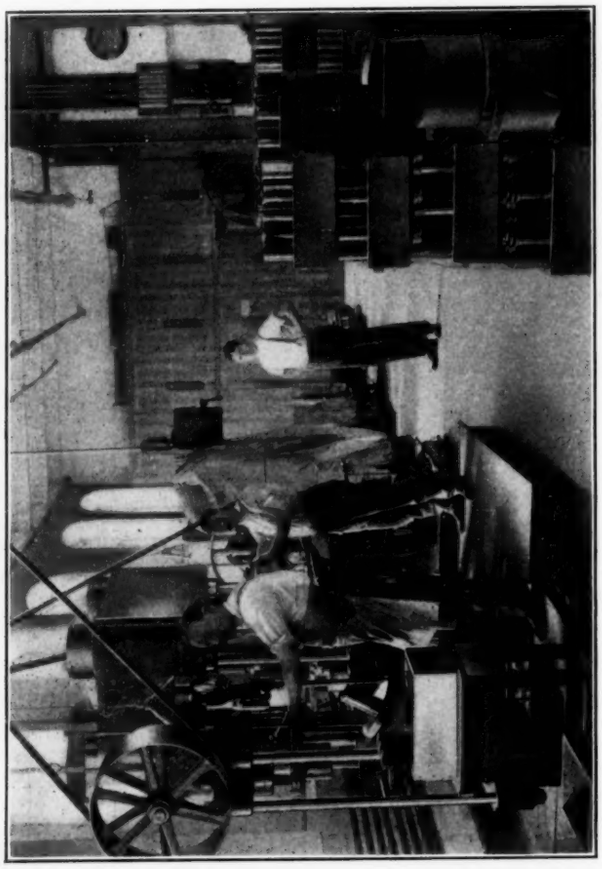


FIG. 53. ARTILLERY CARTRIDGE CASE HEADERS.

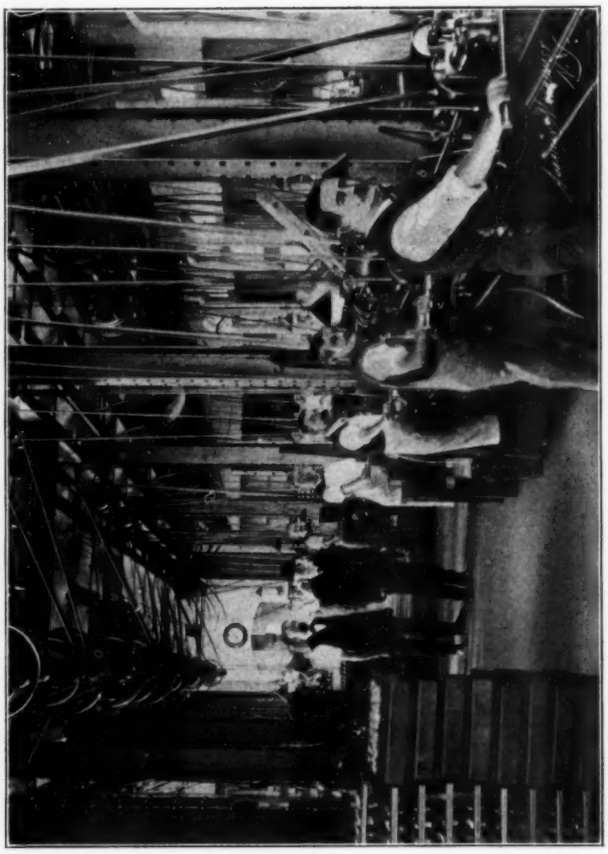


FIG. 55. VIEW IN FUSE DEPARTMENT.

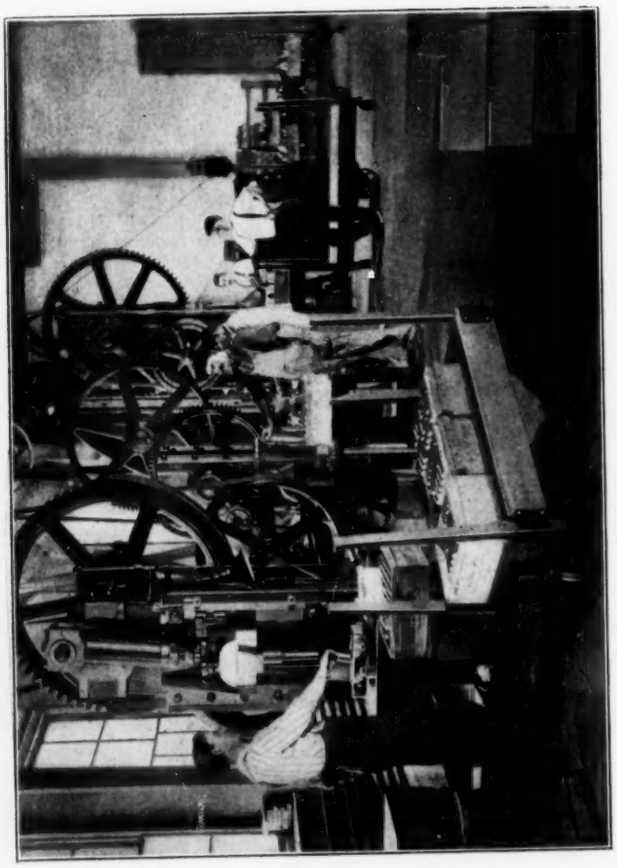


FIG. 52. DRAW PRESSES FOR ARTILLERY CARTRIDGE CASES.

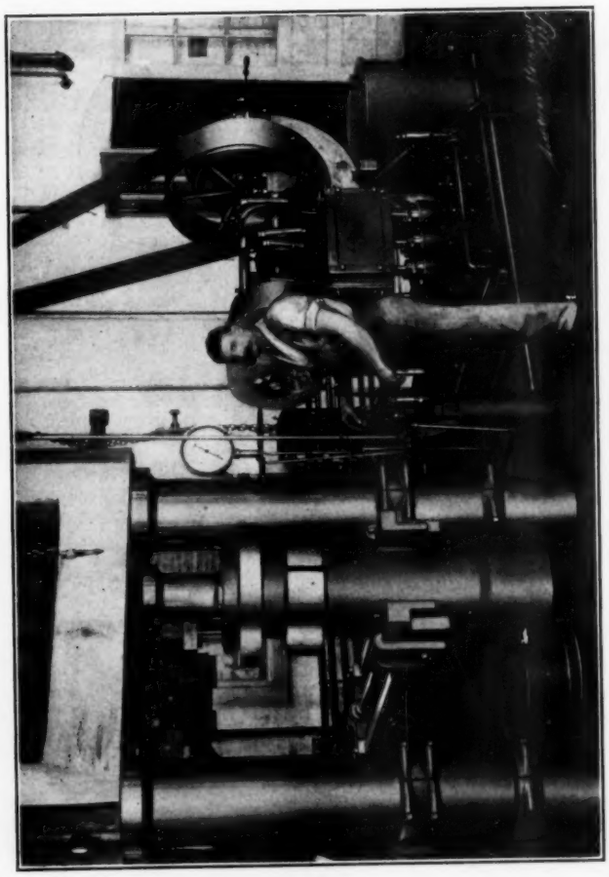


FIG. 54. A 3,000 TON HYDRAULIC HEADING PRESS.

FIG. 57. GROUND FLOOR OF SHRAPNEL DEPARTMENT.

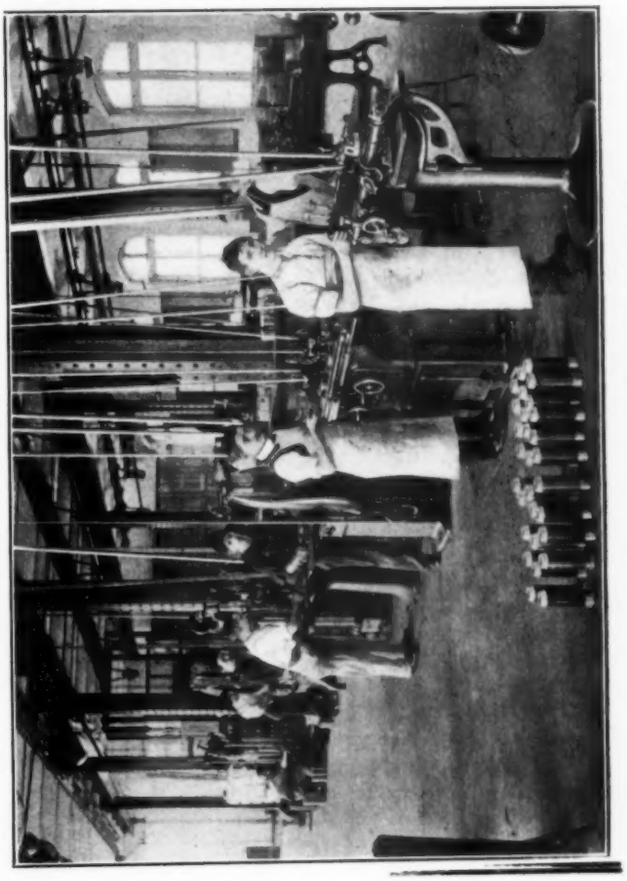


FIG. 59. SECOND FLOOR OF SHRAPNEL DEPARTMENT.

FIG. 56. VIEW IN FUSE DEPARTMENT.

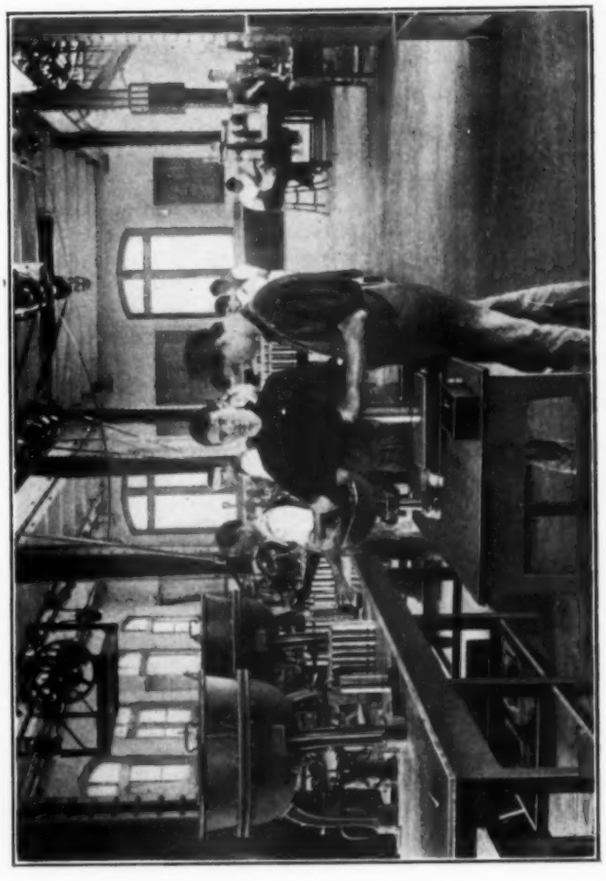


FIG. 58. FILLING SHRAPNEL CASES.

cases when ready for heading are over 23 inches long, ten drawing operations being necessary to bring the original cup up to this length. Six of the draws are made in a 450-ton hydraulic press, the remaining four are accomplished by horizontal drawing machines of from 150 to 350 tons capacity. These presses are all located in the department represented in Fig. 52, though none of them are visible in that view.

The primers for 3-inch cases resemble in size and appearance a .30-caliber cartridge case before tapering. These brass cases are primed the same as a regular cartridge shell, filled with black powder, then placed in a jig and drilled crosswise at a number of points, to allow the flame to communicate freely with the powder in the main case. This jigging of the loaded primers is an interesting process, as the drill goes through the brass and straight through the powder and then out through the opposite wall of the case; but the job is done without actual danger to the workman by means of a sensitive drill enclosed in a box with a sliding door at the front. The drill lever projects from the top of the box and the guard is closed completely except when shifting the jig along or changing the work.

Before the primers are forced into their pockets in the cases they are coated with tinfoil, which is stuck on with shellac, and this confines the black powder and also excludes moisture. Upon the insertion of the primers, the cases are ready for loading. The present capacity of the artillery case plant is about 700 three-inch cases, or their equivalent, per day.

THE FUSE DEPARTMENT.

The floor over the artillery-case shop is occupied by the fuse department, two views in which are presented in Figs. 55 and 56. This branch of the arsenal manufactures centrifugal, ring resistance, time and other fuses for various calibers and types of projectiles, and most of the parts for these devices are produced from the bar on screw machines, the equipment including a large number of hand and automatic machines of various types. There are also a good many sensitive drills, special millers, etc., for performing different operations, the character and arrangement of the equipment being pretty well brought out in the two views.

THE SHRAPNEL DEPARTMENT.

In Fig. 57, a view of the first floor in the shrapnel shop is given. This section of the plant is pretty well occupied with lathes, screw machines and drills. The shrapnel cases, which are of drawn steel, are turned up in the lathe, using a forming attachment, and the diaphragms for the balls are machined in the turret lathes.

The type of shrapnel made for the 3-inch field gun has a ribbed steel case, which does not burst upon the ignition of the charge by the fuse, but instead expels the balls from the end. This steel case, with its contents (over 250 one-half inch lead balls), is loaded in a brass case in the same manner as a solid projectile or a shell would be. The time fuse is screwed into the open end of the steel case and forms a pointed nose for the projectile; and from the fuse to the charge of powder in the base of the case leads a central igniting train, through which, at the proper instant in the flight, the expelling charge is exploded and the balls discharged from the case.

The balls are placed in position in the department shown in Fig. 58. After filling, the case is held under a kettle, where melted resin is run in to pack solidly all openings between the balls; then the steel case is placed in a turet lathe and the outer end faced off, preparatory to receiving the fuse. The case, of course, is provided with a copper rifling band like that used on solid shot and shell.

The view in Fig. 59, the last to be shown in connection with the arsenal, is another part of the room illustrated in the preceding half-tone, and brings out some of the equipment for finishing the shrapnel case; also some of the machines for keeping up the tools.

For courtesies extended during the preparation of this series of articles, my thanks are due Gen. Wm. Crozier, chief of ordnance; Colonel Heath, commandant; Chief Draftsman Brown and foremen of various departments at Frankford.

The Irresistible Force and the Immovable Body.

Proprietor of Big Iron Works—If I understand you correctly, you wish to place an order for armor plate that no cannon shot can pierce. We are turning out that kind of thing every day—

Agent of Foreign Government—No; you misunderstand. I wish to know if you can manufacture a cannon that can pierce any armor plate?

Proprietor—Certainly, sir. We are doing that kind of thing every day, too. —*Answers.*

A correspondent sends us a clipping from a Detroit paper, containing an account of a railway accident which happened in New York City, and according to which "at 50th St., the big engine became stalled on a 'dead center' . Engineer Deyo tried to get the pistons moving by starting the exhaust, but in spite of his efforts he could not get the big machine to turn a wheel." Our corespondent says that if only the engineer could have managed to start the exhaust, how different the result would have been. Perhaps the engineer of the other train failed "reverse the brakes", which, according to the papers, is a plan often resorted to, when something must be done quickly.

The Patent Law Situation.

The following propositions and discussion are presented, as it is thought it may bring out ideas or lead to improvements tending to reduce the waste of money in patent litigation. The first article originally appeared in the *Electrical World and Engineer* of August 26, 1905.

"For the last fifteen years articles have appeared at intervals in the technical press calling attention to the inadequate method of obtaining justice in disputes based upon patents. The last one, by the well-known patent attorney, Edw. P. Thompson, of New York, clearly shows some shortcomings of the present method, but he puts matters rather mildly when he says: 'As the judge in court is only a legal man, a suit at patent law is nothing more than a burlesque or comedy in the eyes of a technical man.'

"Many a man who has the experience of wrong decisions, as well as others who only know about them, charge the judge with being interested or bribed. I, myself, firmly believe in the fairness and strength of character of the judges in American courts, in spite of the many wrong decisions by them and the resulting hardship to many law-abiding citizens, but I wish to point out that the well-known inefficiency of courts in properly dealing with technical cases lowers the prestige of these courts considerably, and may be a direct cause for seeming and actual disregard of laws and ordinances by many.

"The concentration of power in large corporations and trusts has also become a feature of the electrical industry, and oppressive methods for removing competition are but natural consequences. Patents are singularly well adapted to further this end, for under the pretext of the desire to enforce laws and rights, suits can be brought which would make manufacturing unprofitable to enterprises of moderate capitalization. Well-planned attacks by attorneys trained for years in such practice, testimony from experts having flexible consciences, and the inexperience of judges in technical matters are three formidable factors for systematically practicing anarchy under the guise of law.

"Some ten years ago or more steps were taken by the legal profession to overcome the greatest wrongs by presenting a bill before Congress for the creation of a 'Court of Patent Appeal.' Nothing has been heard of this so far. My inquiry at that time into the probable effectiveness of such an organization resulted in statements which may be summarized somewhat as follows: 'It is not all that may be desired, but it is the best we can get at present.'

"In other words, if a firm has been persecuted for several years and has paid thousands of dollars for legal defense, it should be possible to appeal to a court where the subject may be expected to be

reasonably well understood and which would enable the weaker party to get justice and not be crushed out of existence. Time has passed for calling attention to facts; action is required by those desiring a remedy from the present state.

"Patents are interstate grants and rights and the Federal government can be appealed to for the desired change. Below is outlined a plan which it is confidently believed will lead to the desired results if every manufacturer of electrical, mechanical or other devices protected by patents, and every inventor, lawyer or other person interested will respond promptly. It is not believed that a Patent Court of Appeals will give the desired relief, and the plan here submitted consists in part in ascertaining from as many representative firms of various industries, lawyers, patent attorneys, judges and inventors, which system may best remedy for existing shortcomings. The plan consists in the execution of the following steps:

"1. Everybody interested is requested to examine carefully the various remedies or suggestions submitted at the end of this letter and to select from them the form which he considers best adapted to give the greatest amount of justice at the least expense, or if none of these forms suit, to suggest another way, accompanying the suggestion with a brief explanation. The answer should not be formulated in its final shape before the subject has had four weeks' consideration.

"2. The present communication should be shown by inventors, manufacturers and engineers to others, especially manufacturers in other branches, and to patent attorneys and lawyers in their locality, for consideration, judgment and reply in accordance with clause 1.

"3. The answers, which shall be considered strictly confidential, are to be addressed to and collected by the editor of the AMERICAN MACHINIST, such communications to be marked 'Patent Law Reform.'

"4. The correspondence thus collected is to be forwarded to the Bureau of Commerce and Labor, or, as suggested by an eminent jurist of St. Louis, if the correspondence is voluminous, and representative firms, engineers and attorneys recognize the importance of this matter, a memorial may be prepared and handed, with the communications, by a Congressman or the chairman of the Ways and Means Committee, to the President of the United States, who, according to his judgment, may turn the matter over to the proper department or make suitable recommendations to Congress for its attention and action.

"5. In this latter case instructions to Congressmen and Senators by all interested may be desirable, explaining the purpose and results hoped for and asking for their co-operation and support of a bill that will bring about the desired results.

"For consideration and selection, the following modifications of the present practice are respectfully submitted in all such legal cases involving patents:

"1. The court shall call to its assistance in ruling and deciding, in a technical suit, an expert uninfluenced by either complainant or defendant.

"2. A court shall obtain an expert from the Patent Office selected by the Commissioner of Patents or head of the department in which the patent is classified.

"3. A court shall call to its assistance an expert from the Patent Office and another practical or theoretical expert, as the case at hand may dictate.

"4. The judge shall associate with himself a practical and theoretical expert. State or Federal laws to indicate who shall pay for these services.

"5. The creation of a lower and upper Patent Office Court as a separate department of the Patent Office. In such a case the complainant informs the lower court that X is infringing his patent No. —— and presents his side; in due course X is notified by the lower court (as at present in a case of interference) to present his case.

"*a*. If considered necessary, lower court official hears cases in different sections of the country at fixed seasons of the year.

"*b*. All matters not involving patents or technical matters to be referred to a local court for decision.

"6. Suits involving patents to be handled as heretofore, but all testimony to be sent to Washington, for an opinion and assistance from a commissioner, examiner or officer of a department created for this purpose as a separate branch of the Patent Office and manned from the corps of examiners and commissioners of the different departments. Such official to be present at the final hearing of the case and to assist the court in judging the merits of each side.

"7. A court of final appeal to be permanently located in Washington and to be formed by the heads of departments or legal lights of the profession.

"The opportunity is now open to the individual reader to enter these primaries and give his decisive vote for reform, better patent protection and court ruling. The earnest and vigorous support of everyone interested is desired.

"LUDWIG GUTMANN.

"St. Louis, Mo."

With reference to the foregoing letter, the *Electrical Times* had the following to say:

"There is always a great deal of dissatisfaction with the patent laws and their administration. There is good reason for it; patent laws are never satisfactory, at least to inventors. Ludwig Gutmann has written, giving his views, to the *Electrical World and Engineer*, of New York. One of his main contentions is that a patent case should be tried before experts, not before an untechnical judge. It sounds very well to say that an impartial and qualified expert would be the best judge. But how are we to get him? If you ask anyone with those notions whom he would recommend, you find he really means himself, and has no one else to put forward. If you take a concrete example, the difficulty is more easily realized. Suppose there had been an action on the multiphase patents, who would have been a good expert? We want a man who would understand the subject thoroughly, of course, and who has no personal, professional, or trade connection with either side, or preferably with even the experts on each side. But this is not all, by any means. He must understand the rules of evidence, he must be able to deal with two teams of barristers, and he must be well versed in patent law; itself a pretty big subject.

"In Germany, the patent office often gets what it thinks is assistance from various university professors. This is a great hardship to inventors. They find they have to deal with men who start with the idea that practical men know nothing, and never can know or invent anything, and they are unable to see the difference between a chance reference to a fact in a theoretical book, and a worked-out invention. In addition to this they think they know all about the subject *ex-officio*, and absolutely refuse to be taught anything. Anyone who has had experience with the German office has found all this out to his cost. In this country, either side can ask for an expert to sit as assessor with the judge; but I believe no side has ever done so yet. Twice or thrice a judge has asked for an assessor. One reason for this is that the best experts are already retained by the litigants, but the real cause is distrust of the mind that is untrained judicially, and is ignorant of law.

"On the other hand, there is no doubt that the present system, with untechnical judge, semi-technical counsel, and expert witnesses is very bad. In America it is much worse, because the evidence is not taken in court, but on commission, and the experts are not of the same standing as here. But it is very bad here, being slow, uncertain, and ruinously expensive. It might be said two litigants may agree on their own expert and have a sort of patent arbitration. The difficulty is that if such an arbitrator declared a patent invalid, his judgment would only affect that one case, and the whole question would have to be fought out independently next time. Again, an arbitration is generally as expensive as a trial in court, and just as unsatisfactory.

"I have no suggestion to offer. I am not sure that it would not be best to abolish patents and patent law altogether as a public nuisance, and utilize the discontent, thus rendered free and available, for some nobler purpose."

The foregoing editorial was replied to

in the *Electrical World and Engineer* of Nov. 18, 1905, as follows:

"The comment of the English journal, *Electrical Times,* shows that the subject "The Patent Law Situation" can readily be misunderstood, and to correct some erroneous ideas I beg leave to trespass upon your valuable space.

"Few Americans, or American citizens, are dissatisfied with the way in which patents are granted by our Patent Office, or with the general organization, which is believed to be superior to that of other countries. An equally small number is dissatisfied with the patent laws of this country, and, if patents after issue were to remain under the jurisdiction of the Patent Office, very little dissatisfaction would exist. The conclusions derived by your English contemporary are not quite fair, as the subject is general, and of too large scope to deal with individual interests. No laws can ever be framed that can be equally just to *all,* and that is well known and realized by everybody.

"Great discontent has existed for some considerable time, and has caused some to abandon securing patents, others to direct their ingenuity into lines where secret processes of manufacture gave them greater security than patents ever have done; others again, discouraged by the expense incurred in defending the fruits of their labor, have abandoned the field of original work entirely. The existing defects are mostly outside of the patent law proper, and are due mainly to the fact that a patent after issue has neither the protection nor the guardianship of the Patent Office, but, like a ship that is launched from a shipyard, it goes out on the high seas of commerce, to be tossed about, and to fight its own battles.

"It may be of interest to enumerate a few cases of hardships caused by 'existing conditions' (not to be confounded with patent laws).

"An inventor has made a desirable invention, and obtains his patent. After a year or so he notices that one or another manufacturer uses his invention. He calls their attention to his patent; the result is, as experience has shown, a small firm is willing to recognize a patent and to compensate for its use; a large firm, on the other hand, rejects the offer, saying the patent is not good unless it has been upheld by the courts, or, in other words, 'We will use your invention until you have beaten us in the court.' The 'court' does not mean 'Patent Court,' however, but an institution where a man sits in judgment permeated with 'Law' and honest intentions to be just, but who is for some cause or other not permitted to say that he is incapable of judging on a subject matter foreign to his experience and training.

"Manufacturers frequently will not buy the patents, because they can use the invention for a long while before the fact becomes known to the inventor, and if such company is willing to buy, it will offer a very modest sum. The actions of the officials show that they are not afraid of litigation, as they have attorneys by the year, and with the present judges and courts, the chances are in their favor.

"Another hardship results to small manufacturers from the endless number of patents granted on 'modifications' of constructions, which any mechanic would arrive at in the course of his work. These should not be classed as inventions; at present they are so considered and are convenient means for harrassing small makers by instituting suits for infringement.

"Next may be mentioned the interpretation of claims. How these matters operate may be illustrated as follows:

"Suppose a large firm has acquired the rights of some process of manufacture which is well covered by patents. After a few years some modifications are attempted by a competitor, which he regards to be outside the claims of the broad patent, when in fact they were actually infringements. A few years later, a similar invention appears that is actually outside the scope of the broad patent, and the large firm begins to be anxious. It adopts a vigorous policy, and its attorneys institute numerous suits. In a systematic way they attack first those makers whose cases of infringement can readily be proven; the latter, however, are prepared to fight, and both sides lose time and money; generally it takes several years before a final decision is reached. Sometimes the defendant sells its business to the complainant during such a fight, but the suit is not dropped. The absorbed firm is asked to put up a weak defense, and loses the case. The court rules according to the evidence presented, and is, of course, unaware that the former oponents have now a common interest.

"Assume that the company has three or four decisions in its favor. Now it becomes courageous, and studies the case of the manufacturer who is not infringing The attorneys and experts for this company plan the case, and work out a 'line of analysis' to suit their purpose, 'to explain to the court the nature,' having as an excuse, of course, the well-known fact *that the court does not understand the theory.* The juggling done is amazing, and court grasps the improvised 'science.' To help him out further, his particular attention is called to the decisions of former infringement suits with other makers, whose devices and purposes may have been entirely different from the present case. The court, after receiving the voluminous case, studies and compares both sides, and the more he tries to get hold of the theory and differences of the contesting parties, the more mystified he becomes; and he argues somewhat as follows:

"'Here is Judge X, who upheld the patent in New York, and Judge Y in Indiana; also in the Supreme Court Judge Z gave a favorable decision; can I put myself up to be more capable than these three able and learned judges?'

"Courts judge, and are influenced by precedents. The decision of a court under such conditions, can hardly be wondered at.

"Let us now take the concrete case mentioned by the *Electrical Times.* Suppose a court is sitting in judgment and both sides send in their evidences. Now let it be provided by an act of Congress that all technical matters must be sent to Washington to a lower Patent Office court, which may be made up of former commissioners, examiners, etc., permanently or temporarily connected with such a court. Would it be difficult for two or three of the examiners of the present Patent Office force, who have had polyphase patents to examine for three or four years, to know in any particular case submitted to them who is infringing, what the claims really cover, and whether the scope of the claims is not stretched by the complainant? It seems to me a logical conclusion that those who can grant patents must be able to judge, especially as they make it their daily business.

"If the present system is in part to be continued, the judge could make his ruling, so far as he is competent; but would it not be well to have all technical matters turned over to a Patent Office court, or a department of officials who do not require to be educated by primary methods for the occasion? In order to judge wisely, the subject matter should have been understood for a considerable period, which cannot be expected in the brief time of the trial. On this point, a well known St. Louis jurist expressed himself as follows:

"'In order to have sound judgment in any domain of reasoning, the matter considered should have been previously assimilated and transfused into the mind that reasons thereon, so that every element thereof should be valued in due proportion with all other considerations bearing thereon.'

"This statement is to the point; in all matters in which courts are *versed,* they show sound judgment, but in matters that take years of training it can hardly be expected that a court can have 'sound judgment' or absorb 'science' by reading or studying for three or four weeks a subject unfamiliar to them. The opposing parties to a suit could employ experts if they choose, or do without them. If the case is certified by the trial court to the 'technical court,' or department in Washington, this latter court should try, consider and determine the precise points submitted to it, and counsel should be notified, to have an opportunity to submit oral and printed arguments.

"This technical department or court is not to decide questions of law, but questions of fact. The Patent Office library is at its disposal, and so far as knowing the

state of the art is concerned, no one has ampler resources. For this reason it is much less influenced by opinions on either side, and will not accept an unfair interpretation of a claim, nor allow an enlargement of the scope of the patent; abuses which are fostered by the existing system.

"Under such a system, where examiners versed in their specific departments as just outlined are employed, the necessity of 'experts' dwindles down considerably. The selection of the judges in a patent court might be made without public notice, should there be any fear that they might be subjected to undue influences, and justice may be expected under such conditions more speedily than under the present state.

"Suppose the owners of the polyphase patents mentioned by the *Electrical Times* could have the infringement suits tried before a court consisting of the examiners that granted the claims, they might have had decisions thereon in their favor within a year or two, instead of five or ten years' litigation. The complications arising in England and Germany are unfortunate, and should be avoided in any system that is to take the place of the present system here. Two ways occur to the writer at present, and no doubt others better qualified may be able to find better ways or suggest more suitable means.

"Suppose that a department, or advisory board, were created in the Patent Office for the purpose of rendering assistance when called upon by the courts. This department receives the cases of the opposing parties from the courts, studies them, and gives a summary to the courts, which summary will guide the judges in their decisions. These conclusions of the Patent Office advisory board could be or should be incorporated in the decision rendered. This advisory board of the Patent Office may be presided over by the Commissioner of Patents, or some official duly appointed, while two men are given the task to study the case on both sides. They may discuss and weigh the merits of the different points brought forward by both parties, and if their views are the same they make a report to the Commissioner of Patents, or superior official, after a hearing is given to both sides, and draft the reply to the court seeking the information. If the two investigators have different opinions, they bring these points before the superior officer, who becomes a member, and the decision of the greater number is reported to the court. There is something in favor of a secret Patent Office board, whose examiners may be changed for each case, and whose names do not appear. Not only would any undesirable influence be avoided, but the examiners would act more independently.

"The second is a lower Patent Office court, to whom all technical suits must be reported, and which decides the technical side of the infringements, rights or wrongs, and at this stage turns the subject over to the proper court for the civil actions resulting from the finding. Here again the examiners, who are supposed to be technical men should be persons who know the subject they are dealing with, and if they do, the selection of experts for presenting the cases (which question seems to be the all important one of the *Electrical Times*) drops out entirely. For the party that is not infringing, although accused of such act, can generally show this without great effort, and any attempt made by capable lawyers and experts to deceive will avail them nothing. It would be wrong to draw conclusions from the statements of results observed in England or Germany. Those conditions do not fit the American case. The English patent is granted without great search to any applicant; the class spirit of German professors does not find fertile ground on the American continent, while all the desirable qualities enumerated in the *Electrical Times* for an expert are found in the officials that would form such advisory board or Patent Office court.

"The questions raised are of interest to many, and many should contribute their views freely. We are singularly fortunate in having an administration like the present, which makes the solution of such questions as these its duty, if they are shown to be weighty and of importance. This very point, however, can only be shown by a hearty and vigorous response and co-operation.

"The opinion of others is invited."

Standard Sizes for Catalogues.

It is strange how some people can sleep through a sermon and the entire reform movement which follows it and after everything is decided, wake up and start a reform campaign of their own, which in reality only results in confusion for everybody. Some fifteen years ago the question of standard size for catalogues was extensively discussed by a number of engineering societies, and the committees appointed by them recommended 9x12 as the largest size; 6x9 for the regular catalogue size; 4½x6 for medium size catalogues and 3x4½ for small or pocket size catalogue. The AMERICAN MACHINIST changed the size of its paper to correspond to the 9x12 standard, and since that day most of the leading technical papers have adopted the standard size. Among these we may mention the *Engineering and Mining Journal, Power, Mines and Minerals, Hardware and Metal, The Electro Chemical and Metallurgical Industry, Fuel, Woodcraft, The Boiler Maker, The Marine Review* and *The Iron Trade Review*.

The 6x9 size for catalogues has been adopted by practically all of the largest manufacturers, such as the Westinghouse Companies, the Allis-Chalmers Company, the Link Belt Engineering Company, etc. The Link Belt Engineering Company publishes on the outside of its catalogue "6x9 standard size, as recommended by the American Society of Mechanical Engineers."

One of our subscribers recently wrote in asking for the proper size for a catalogue. We gave them a statement something as above and they adopted the 6x9 standard, but we have just received a letter from them calling our attention to the fact that the Southern Hardware Jobbers' Association has appointed a committee on standard size of hardware catalogues that has recommended 8¼x11 inches as the standard size for regular hardware catalogues, and 9½x11 as the standard size for loose-leaved catalogues. It must be that our Southern friends are still in their old prebellum sleep and have not, as yet, awakened to find that the world do move. When a matter has been as thoroughly threshed out as this standard size catalogue matter has, and has been in use for a decade and a half, it certainly tends to confusion to have some other association come along and set up a standard of its own.—*The Foundry.*

Bonus Distribution.

The semi-annual bonus distribution at the Remington Standard Typewriter factories of Wyckoff, Seamans & Benedict, Ilion, N. Y., took place in the Factory Hall on Saturday, December 23. John Calder, manager, divided $12,250 in gold among the 245 employees selected at this time. These persons have all been at least ten years in continuous employment with the company and have maintained a good standing and high efficiency. There are 3 thirty-year, 3 twenty-five year, 28 twenty-year, 103 fifteen-year and 108 ten-year men among the large force employed. At the same time the prizes and framed certificates for good suggestions from employees adopted during the last six months were distributed.

Wireless telegraphy, it is announced, will be utilized in the survey work of the Grand Trunk Pacific Railway, now in progress in northern Ontario and Quebec, for the purpose of communicating with the survey camps. At the present time it takes five or six weeks to send a communication to some of the engineering parties in the field and receive an answer from them. The first wireless station will probably be erected at New Liskeard and another in the vicinity of Lake Abitibi. From the latter point, east and west, there will be wireless offices established at distances of forty or fifty miles apart.—*Commercial America.*

Tin which has been melted several times always contains a proportion of oxide produced by the surface oxidation of the metal. The quality has, of course, been deteriorated by the presence of the oxide.—*The Metal Industry.*

The New Works of the Ingersoll-Rand Drill Company at Phillipsburg, N. J.—VI.

THE BLACKSMITH SHOP.

This series of articles descriptive of the new and already extensive plant at Phillipsburg was begun while some of the buildings were incomplete and others only partially occupied. As a consequence a preliminary planning of the narrative as a consistent and symmetrical whole, and an arrangement of the different departments in natural relation and sequence was not possible. We began quite properly with the foundry, as providing the material to be worked up, and next to that would naturally have come the blacksmith shop, the function of which relatively to the whole is similar, but this was the last of the buildings to be completed and occupied, and so it comes last here also. The blacksmith shop proper and the oil-treating department, being closely related, and being also under the direction of a single responsible head, are here treated of together.

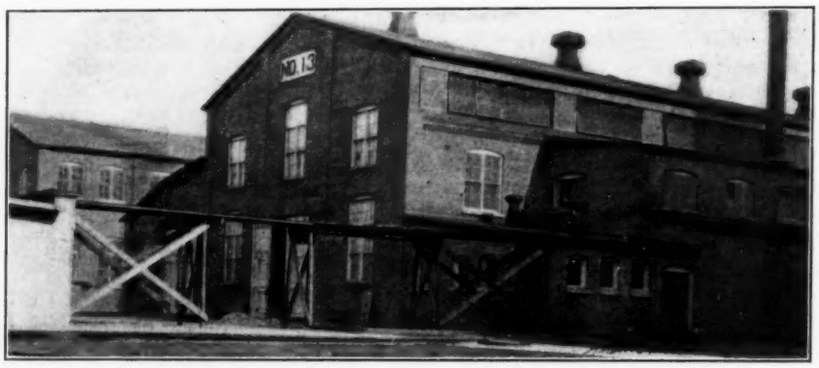


FIG. 71. FRONT OF BLACKSMITH SHOP.

As considerable steam is used by the hammers in the blacksmith shop, it is properly located next to the boiler side of the power-house. It will be remembered that no steam is used in any other building of the plant except for the testing of some of the rock drills and the steam-driven air compressors.

Fig. 71 is a snapshot of the west end or front of the blacksmith shop, the office being in the low lean-to in the near corner. Figs. 72 and 73 are elevations of the north side and the east end, respectively. Fig. 74 is a vertical cross-section, with a plan showing the general layout, location of tools, sweep of cranes, etc., and Fig. 75 is a general photographic view of the interior, satisfactory enough as far as it goes, but still showing not more than one-half of the floor space. Most of the west end, with a little more than one-half of the north side, is here seen. The design provides for the unlimited extension of this shop toward the east, as may be required.

The present open floor space of this shop is 120 by 78 feet, the clear height to the central truss being 30 feet. The space in the lean-to at the south, occupied by the large heating furnaces with their coal-bins, the office, etc., is in addition to this. These two reverberatory furnaces have a battery of Stirling boilers between them which utilize a large portion of the waste heat. The steam pipe from these boilers delivers into the large steam main, so that the fluctuations in the volume of steam thus delivered do not impair the steadiness of the general supply which is controlled and regulated in the power-house.

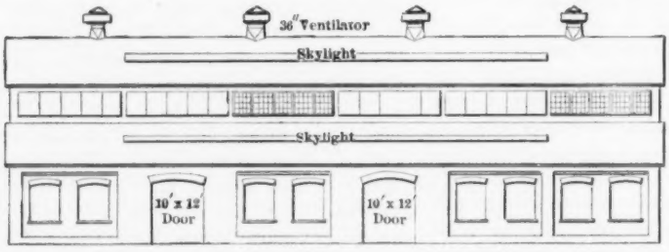


FIG. 72. ELEVATION OF NORTH SIDE OF BLACKSMITH SHOP.

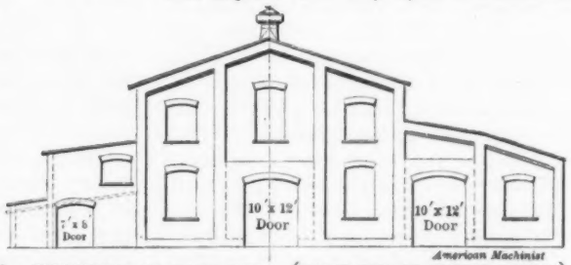


FIG. 73. ELEVATION OF EAST END. (WEST END IS DOTTED LINES.)

Fig. 76 shows the front of the left-hand furnace. There is a 2,500-pound hammer just to the left of this view. Fig. 77 shows the front of the boiler stack. Here is a rack where a large variety of tongs are kept and also the hammer dies most immediately in use. There is a large collection of dies shelved at the west end of the building.

Anyone familiar with blacksmith-shop interiors is struck at once, upon entering here, with the clearness and purity of the atmosphere, although the lighting of this building is not perhaps as noticeably good as in some of the others. Down-draft forges are used exclusively, and not only is the visible smoke from the soft-coal forges thus taken care of, but the hard-coal and the oil-heating furnaces also are hooded over and connected with the general suction.

The hammers, presses, etc., indicated upon the plan are not yet all installed, the present list comprising on the floor: six steam hammers, three drop hammers, one bulldozer, two power presses, one hot-saw, special machines for forming rock-drill steels, emery wheels, grindstone, etc. Motors, blowers, suction fans, etc., are upon elevated platforms and occupy no floor space.

This shop is already turning out a large quantity of work, but its operations go on with remarkable smoothness and lack of noise and confusion. Gangs of four operate the large steam hammers, and their movements are so systematized that they work together apparently as automatically as the parts of an elaborate machine. The entire series of operations involved in, for instance, the forging of a rock-drill piston from the billet, is carried through without a word being spoken and only an occasional nod of the head of the hammerman.

OIL-TREATING DEPARTMENT.

This special shop, a snapshot of the exterior of which is given in Fig. 78, with a general view of the interior in Fig. 79 and a plan and elevations in Fig. 80, is an installation of unusual importance in connection with the work of this company. Rock-drilling and mining machinery is subject to severe shock and stress, and much of the success in its production depends not only upon the material used, but also upon the treatment of the material in the various processes of manufacture. The special treatment here given to the responsible parts of rock drills and air compressors has greatly increased their efficiency and longevity. This special treatment has developed through a continuous and continuing course of experiment, and it is not permitted to us to speak in detail of the operations carried on. It may be said that every Sergeant rock-drill piston now receives in the course of its manufacture, and after the completion of the forging, four distinct and separate heat treatments, and that the results fully justify the time and

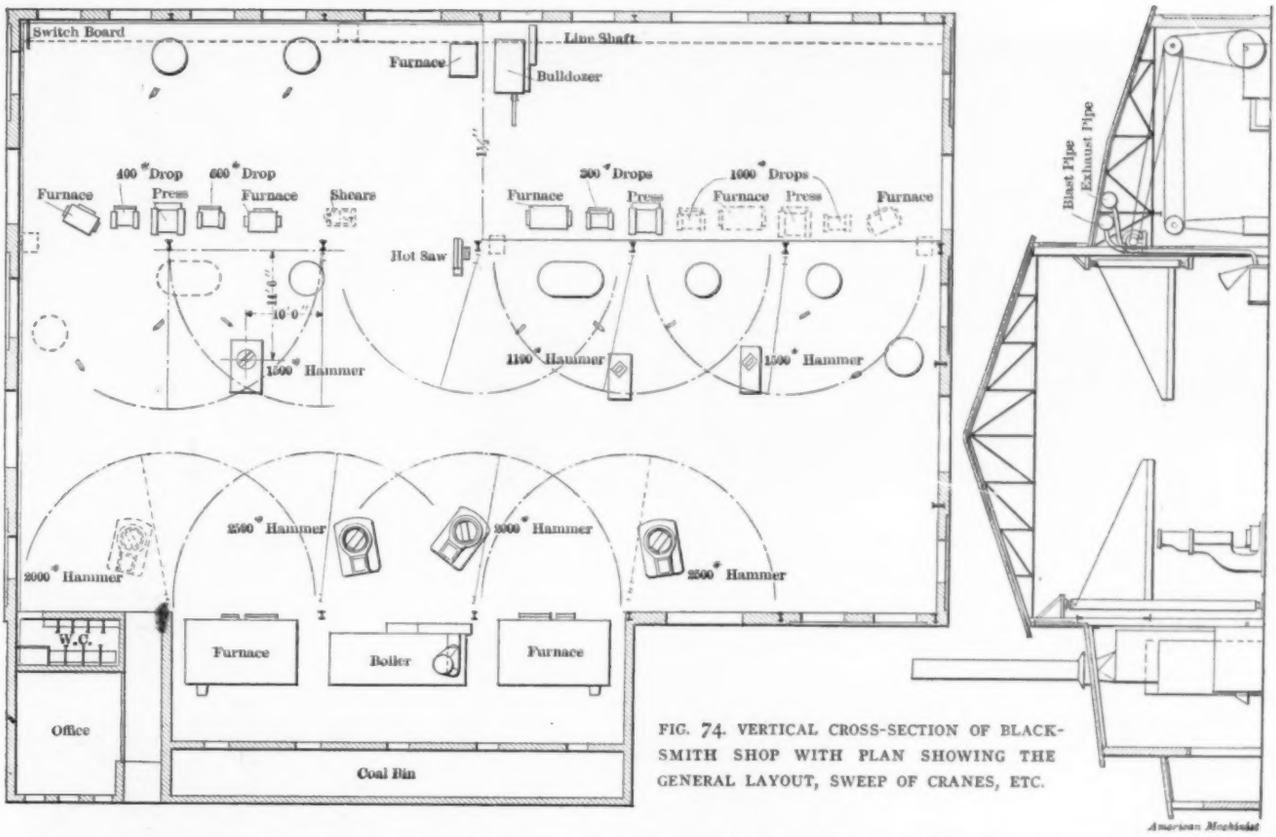


FIG. 74. VERTICAL CROSS-SECTION OF BLACKSMITH SHOP WITH PLAN SHOWING THE GENERAL LAYOUT, SWEEP OF CRANES, ETC.

expense involved. These pistons are made of carefully specified, rigidly inspected, high-carbon, open-hearth steel, and the conditions which have been found to be best, both of the forging from the billet and of the subsequent treatment in this shop, have been carefully and persistently investigated, and are all now narrowly defined and strictly insisted upon. While

FIG. 75. INTERIOR OF SMITH SHOP.

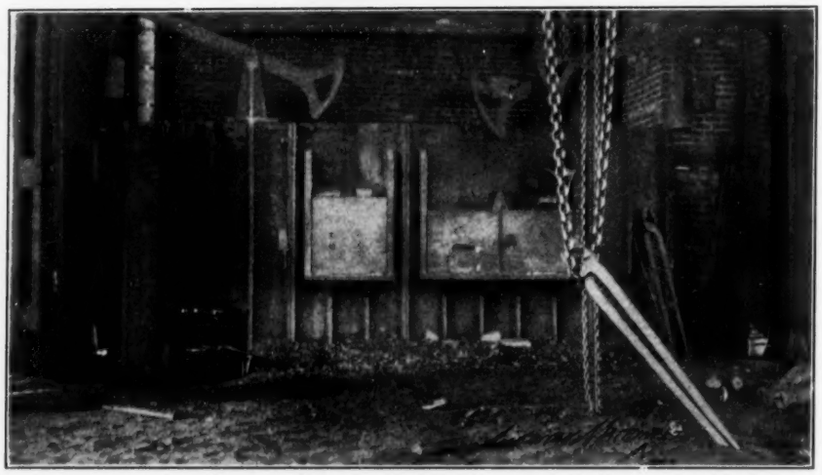


FIG. 76. FRONT OF LEFT HAND FURNACE.

the absolutely best in practice is of course not attained, the better is constantly striven for.

The designation of this shop as the "oil-treatment" department is hardly satisfactory or sufficiently comprehensive, as various other operations are carried on here besides the oil treating. One important function is that of annealing, which is done almost as extensively as the oil treating. Case-hardening also is another specialty, various pieces being case-hardened in quantities by packing in boxes with suitable carbonizing material, heating for a length of time greater or less according to the depth of hardening desired, and then suddenly cooling. Local case-hardening, by the familiar processes, but with specialization of detail, also is done here upon rock-drill pistons, jack-screws and other parts. Tool forging and tool hardening and tempering for the entire works are done here.

The equipment of this shop, therefore, is a more elaborate one than is suggested by the name of it. Entering the doorway at the south end, Fig. 78, we have the view as in Fig. 79. The floor dimensions are 138x56 feet, which does not include the lean-to on each side. The large furnaces are ranged along the east or right-hand side. In the middle of the floor are the two large oil tanks with wide water spaces under and around them and compressed air in considerable volume constantly blowing up through the oil. These tanks have covers at the sides mounted upon inclined ways, and always ready to slip over in case the oil should take fire, which, it is believed, has not yet occurred. Fig. 81 shows the cover over the tank. The tanks are thus covered at night and over Sunday.

Beyond these tanks are four round oil tanks with water jackets, and beyond them brine tanks, with a soda-water tank and another of clean hot water. The tool forging is done in the farther left-hand corner, which is shown in Fig. 82. The steam hammer here is operated by compressed air. The packing of the case-hardening boxes is done in the right-hand corner. Returning along the left-hand side, there are several small gas furnaces, lead baths for heating tools, oil baths for tempering (all the tool-tempering being done in this way instead of by color), brine tanks and oil tanks for hardening, and case-hardening solution pots. The combined capacity of the brine tanks is quite large, and they are all connected with a large storage tank in the ground outside the building, a constant circulation being maintained by an electrically driven pump. The gasolene tank from which the gas supply for the furnaces is generated is located in the yard, at a distance from the building. There are also in use here a two-spindle centering machine and three lathes with hydraulic straightening apparatus attached. Fig. 83 shows a couple of steel baskets or carriers, their bottoms full of large holes, with batches of discharge valves of air compressors in them awaiting treatment, and back of these are piles of partly finished drill pistons. R.

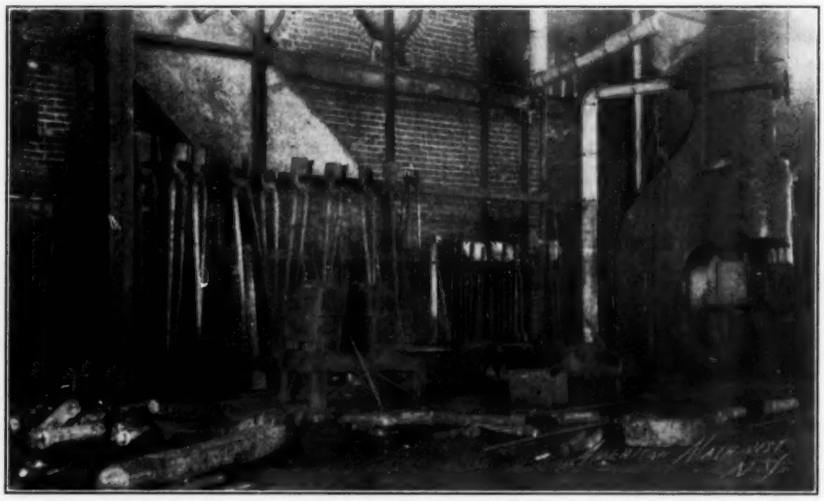


FIG. 77. FRONT OF BOILER STACK.

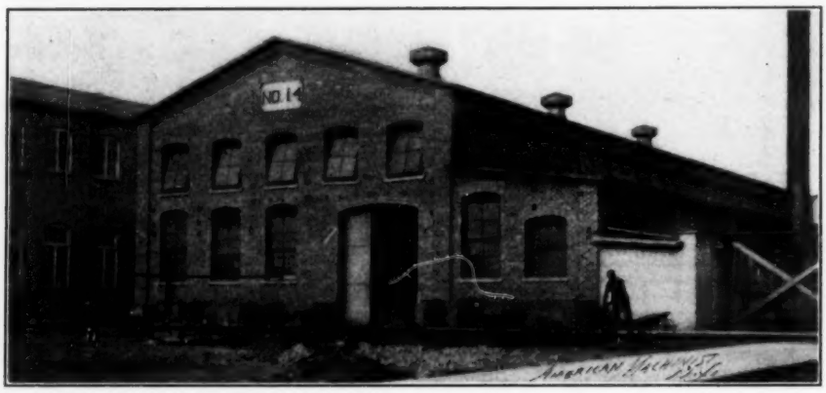


FIG. 78. THE OIL TREATING DEPARTMENT.

Plaster of Paris, mixed thick with a little thin glue, makes an excellent material to plug holes too large for putty, in woodwork which is to be painted. Fill according to scripture, and, after it is set, smooth off with sandpaper on a block. —*The Wood-Worker.*

Practice leads toward perfection, except when it is lying or deciet that is practiced; then it leads to future trouble.

FIG. 79. INTERIOR OF OIL TREATING DEPARTMENT.

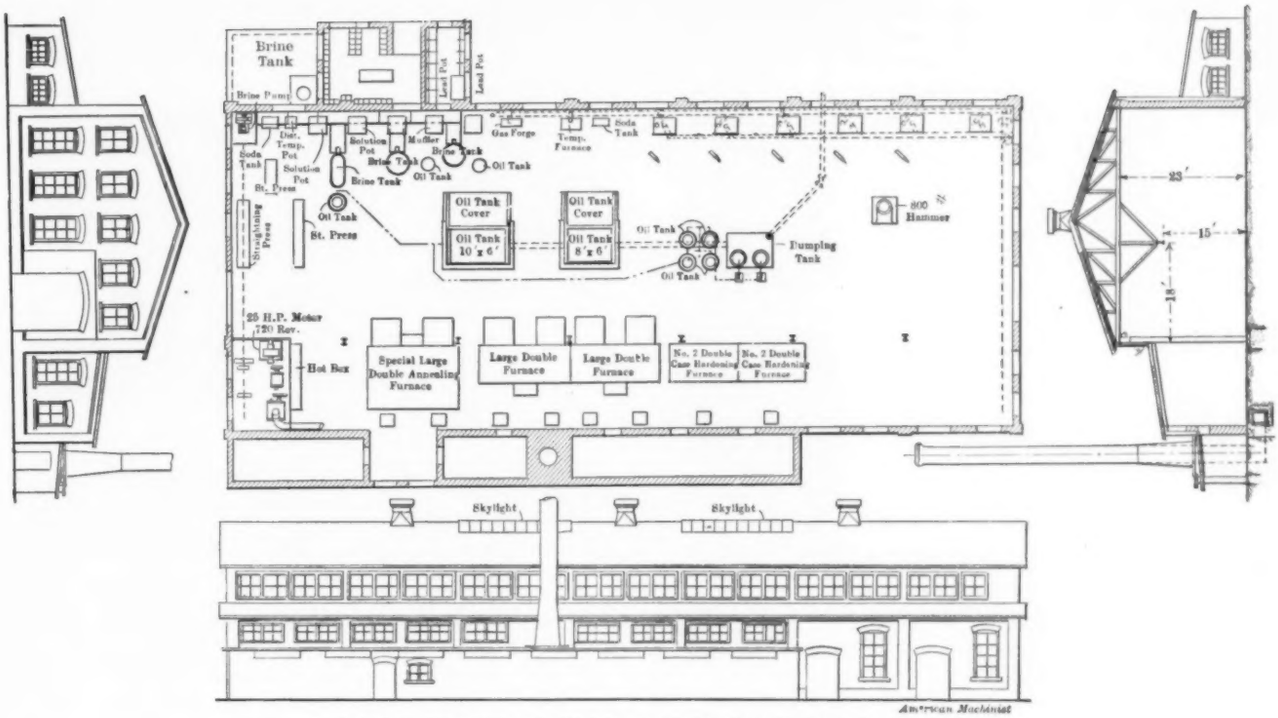


FIG. 80. PLAN AND ELEVATIONS OF OIL TREATING DEPARTMENT.

Japanese Machinery Imports.

Special Agent Crist, in the *Daily Consular and Trade Reports*, describing business in Japan, has the following to say with reference to machinery:

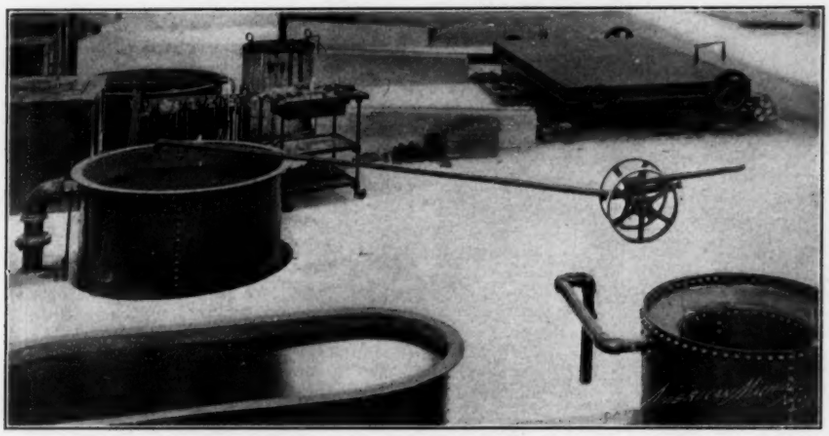


FIG. 81. SHOWING COVER ON OIL TANK.

Stationary engines for cotton mills are in most cases purchased in England. The original purchases of stationary engines were made in England with feed pump, air pump, and condenser directly connected. This is not a present-day American principle, and though the American type may possess many advantages over the English engine the conservatism of the Japanese holds strongly to the original style, and to the present no great headway has been made in changing his desire for this kind of engine.

Steam turbines from America have been introduced of late with much sucess, and a good field will open for such machines in the near future. Machine tools, lathes, planers, shapers, plate rollers, steam hammers, etc., of the heavier types come mostly from England, while the smaller sizes of American make are most preferred. The question of price and quickness of delivery appear to be influencing factors in these lines. Notwithstanding the reputed ability of American concerns to effect quick delivery of manufactures in iron and steel, on a recent large order of machine tools the time quoted from America was fourteen months, while English manufacturers agreed on delivery in eight months.

FIG. 82. BLACKSMITH CORNER.

Loss of Heat from Iron Pipes.

A paper was recently delivered before the Canadian Society of Civil Engineers by Mr. R. W. Leonard on the above subject. The author speaks of the loss of heat from pipes carrying warm water, and goes on to say that he made experiments on 1in. and 2in. pipes, black, and rusty black or ordinary type, on 2in. pipe and 28 and 26 gage, or 0.016in. and 018in. thick, on 2in. lap-welded boiler tube and 1in. welded galvanized steam pipe. The pipes were filled with warm water and exposed to air. A 2in. black pipe 0.154in. thick, containing 5lb of water, had a surface of 2.20 square feet, being 3.54ft. long. It cooled from 142 degs. Fah. to 32 deg. Fah., and lost heat at the rate of 124 British thermal units per hour in still air at 7 degs. to 10 degs. Fah. Cooled from 126 degs. to 32 degs., the loss was 112.6 units under the same conditions, and 217.3 units in an air curent of 8 to 12in. per second at 5 degs. to 7 degs. Fah. of temperature, thus showing the extreme importance of non-movement. In water at 32 degs. Fah. the same pipe lost heat at the rate of 309 units per hour when cooled from 126 degs. to 32 degs. and at 269 units when cooled only from 116 degs. to 32 degs. In a current of only 1½in. per second of water at 32 degs., and cooling from 116 to 32 degs. the loss was as high as 849 units per hour. Cooled from 142 degs., to 32 degs. a 2in. pipe only 0.095in. thick cooled at the rate of 136.7 units in still air of 7 degs to 10 degs., of 385 units in a current of 1½in. per second. Thin galvanized pipes lost at higher rates, and thin-tinned pipes at still higher rates. The figures obtained are consistent.

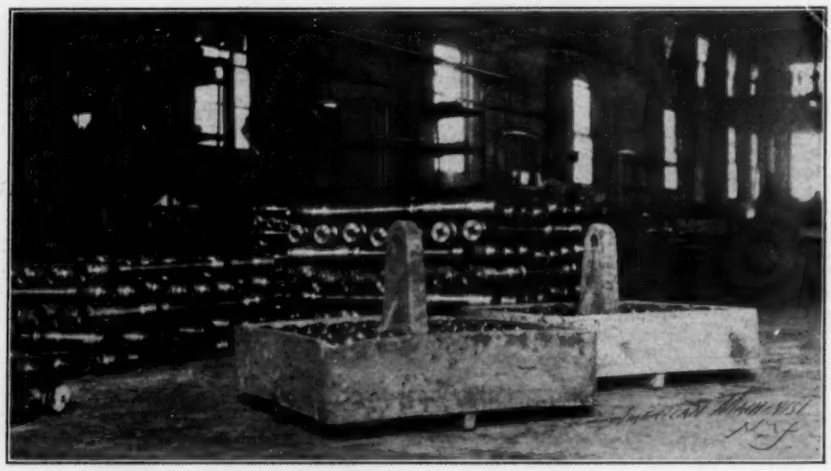


FIG. 83. CARRIERS WITH DISCHARGE VALVES.

The Second Tunnel into New York

Early in October the Hudson Companies completed the south tunnel tube of its underground route from Jersey City to Christopher street, New York. This tube is the second of the tunnels driven under the Hudson River bed, and it is expected that electric cars will be operating by this route within a year or eighteen months. The northern tube was finished about a year ago. It was started in 1874, and after a checkered career came into the hands of the New York and New Jersey R. R. Company. This company gave out the work to the Hudson Companies, which completed it in one and a half years. The present tube has been two years in the course of construction. The tubes will cost when completed, about $13,000,000, and the entire work will cost about $30,000,000,. The tubes are 5,700 feet long, 15¼ feet in diameter and are intended for one track each, with a sidewalk for workmen. Two tubes have been started by the same interests on the New Jersey shore, to run under the river to Cortlandt and Church streets. These new

tubes will be 16¼ feet in diameter. The tubes just completed will probably connect on the New Jersey shore with the Pennsylvania and the Lackawanna terminals. In Manhattan one branch will connect with the subway under Fourth Avenue, at Astor place. Another branch will run to Sixth Avenue and Thirty-third Street.—*Commercial America.*

The Kerr Steam Turbine.

Our readers will recall the paper on "Simple Steam Turbine Engines" by John Richards, which was published at page 629 and 660, Vol. 28, Part 2, in which the use of wheels of essentially the form used in the tangential water wheels which are so largely used on the Pacific Coast was urged and their early appearance in commercial form was predicted. The prediction has come true at an earlier date than Mr. Richards probably expected, in the turbine made by the Kerr Turbine Company, of Wellsville, N. Y., some features of which are illustrated herewith. It is true that in other respects the Kerr design differs from that recommended by Mr. Richards. Thus the Kerr machine is compounded, while Mr. Richards recommended the simple construction and, contrary to Mr. Richards' recommendation, this machine has packing on its central spindle, but the appearance of the Pelton bucket in steam turbines for general service is certainly highly significant.

Perhaps the most widely known of steam turbines at present is that of the Parsons type. Compared with the still more widely known water turbine, so long and efficiently used under low heads of water, the Parsons steam turbine is a water turbine with many sets of guides and vanes arranged in series or compounded. The Kerr steam turbine is built on the principle of the Pelton water wheel which has been so successful under high heads of water. It is a nozzle and bucket turbine as compared with the guide and vane type. In both types the impulse or push on the vane or bucket due to change in direction of the flowing steam is the source of power. In the steam engine, it is the pressure on the moving piston.

The Pelton or double-cup form of bucket gives a nearly complete reversal of the jet of steam and the proper velocity of bucket for complete absorption of the energy of the jet is one-half the velocity of the jet. But when steam of high pressure is expanded down to atmosphere or into a vacuum the velocity may be from 3,000 to 4,000 feet per second. By compounding or dividing the drop of steam pressure into several steps or stages the steam velocity is lowered enough to secure an efficient turbine. An advantage of the nozzle and bucket type is that by varying the number of stages, the size and number of nozzles and the bucket velocity a wide range of speed and power conditions can be met with a turbine for each case.

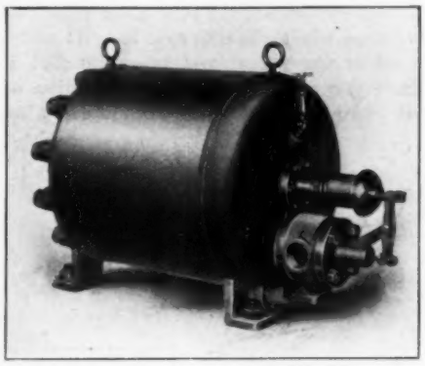


FIG. 1. THE KERR STEAM TURBINE.

The shell of the turbine is made up of steam and exhaust end castings and a number of similar castings or diaphragms between. Within the chambers thus formed are steel disks with double-cup buckets dovetailed into the rims. The steam passing from one stage to the next is directed into these buckets in tangential jets. One or more disks and single or multiple nozzles may be used in each stage to provide for power required or the expansion of the steam. The joints between the sections are made by wick packing in a tongue-and-groove joint backed by a metal to metal outer joint. As through bolts are used to hold the sections together, the action of steam pressure is to close all joints but the first more tightly.

The disks are made of flange steel and the buckets are drop forged from mild steel. The buckets are secured to the disks by dovetails lightly riveted. The disks are secured to the shaft by split hubs and lock-nuts so arranged that the impulse of the steam jet tightens the disk in place. The disks are balanced separately and the small errors tend to neutralize each other when the disks are assembled on the shaft. Troublesome mass balancing is thus avoided entirely.

The nozzles are made from cold-rolled steel and secured in place by beading like boiler tubes. The shaft packing between stages consists of pressure seated floating rings which center themselves with the axis of rotation and tend to dampen vibration while preventing leak of steam. The body and steam end of the turbine are lagged to reduce radiation.

The steam end bearing also serves as a stuffing-box and the journal rotates in a bath of cylinder oil. Where even a slight leakage of oil into the exhaust would be objectionable, a water-sealed gland is used at the exhaust end and the bearing is of the external-ring oiled or forced lubrication type.

The governor is of the throttling type mounted on the end of the shaft and concentric with it. The weights are semi-circular in section and have a three-point support which secures a pure rolling contact and dispenses with oil. A lever connects the governor spindle with the balanced throttle valve. The arrangement is such that in case of a spring breaking or the lever being removed the valve instantly closes.

While no theoretical limit to size appears the turbine for the present is offered in sizes ranging from 5 horse-power or less up to 1,000. The design provides for manufacture in standard parts rather than as complete units. This secures interchangeability and low shop cost, while permitting the design of a given unit to be suited to service conditions.

The steam turbine, like the water wheel, is not by nature reversible and hence cannot serve all the purposes of a steam engine. Its strong point is in high-speed direct-connected work with generators, centrifugal pumps, blowers and the like.

Of the accompanying illustrations, Fig.

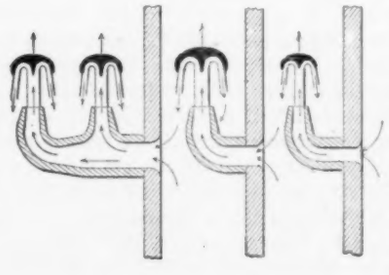


FIG. 2. NOZZLES AND BUCKETS SHOWING METHOD OF COMPOUNDING.

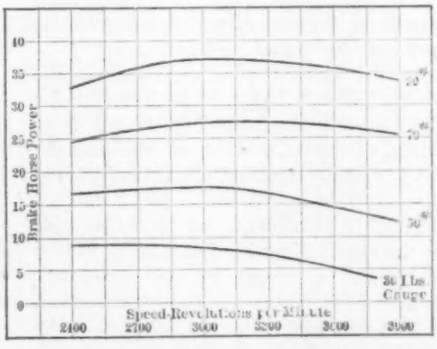


FIG. 3. SPEED-POWER CURVES FOR VARIOUS INITIAL PRESSURES. 18-INCH 5-STAGE TURBINE NON-CONDENSING, DESIGNED FOR 3,000 R. P. M. AND 30 BRAKE HORSE-POWER

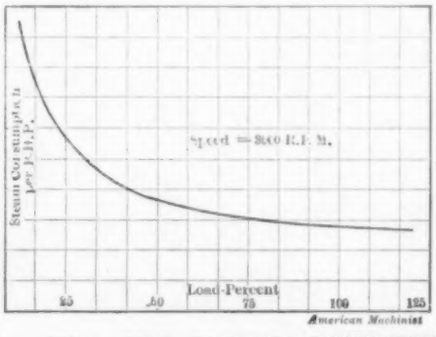


FIG. 4. FORM OF STEAM CONSUMPTION CURVE FOR NON-CONDENSING TURBINE, WITH THROTTLING GOVERNOR.

1 shows from the governor end a complete turbine of 30 brake horse-power for low-pressure steam, non-condensing. Its speed is 3,000 revolutions per minute, the floor space occupied being 20 by 36 inches and the weight 600 pounds. The other illustrations are self-explanatory, except that it should be remarked that Fig. 4 is intended to show the form of the steam consumption curve and not the actual consumption.

Iron vs. Steel—Experience of the Pennsylvania R. R.

Speaking at the recent Washington meeting of the American Institute of Mining Engineers, Dr. C. B. Dudley gave a highly interesting description of the experience of the Pennsylvania Railroad Company as to the comparative values of iron and steel as constructive materials. He stated that there is now a tendency to return to the use of wrought iron in certain situations, whilst for the past twenty-two years the trend has been in the opposite direction, under the belief that the substitution of a homogeneous, well-made metal like steel must be an improvement on the use of iron—a non-homogeneous material, liable to suffer from flaws and bad welds. The experience of twenty years, however, had, he said, at length led to the conclusion that in certain constructions steel is proving less satisfactory than had been expected. This might be partly due, he continued, to the use of a steel ill-adapted for the work, or to faults in design or in workshop treatment; but he was also inclined to believe that there was a fourth cause. The trouble with steel had always appeared in articles subjected to bending. When subjected to direct tension and compression, on the other hand, it always showed itself much the better metal. Thus it had been found by experience on the Pennsylvania Railroad that the calculated stresses might at some points of a steel axle be 18,000 lb. to 20,000 lb. per square inch, whilst at others only 7000 lb. to 12,000 lb. per square inch. Using steel of 65,000 lb. to 70,000 lb. tensile strength such an axle will sooner or later fail in service under these maximum stresses. The method of failure is peculiar. It generally begins at the fillet of the shoulder. The outer fibres give way first without showing any elongation, and their failure is followed by that of the fibres then exposed to the maximum stress, until finally the journal snaps off. If the steel is from 80,000 lb. to 85,000 lb. tensile strength, such failures will not occur. On the other hand wrought iron of but 48,000 lb. to 52,000 lb. tensile stress will stand successfully the same fibre strains as require a steel of 80,000 lb. to 85,000 lb. tensile strength.

The man who can get good work out of a poor machine generally deserves a better machine.

Letters to the Editor.

Lathe Design and Practice—Gibbed Sliding Heads.

Mr. Fish, at page 527, Vol. 28, Part 2, says, regarding the straight, set-screw adjusted gib, "Almost all our tool designers, myself included, have, and probably always will, use this device, because it is cheap, and profits must be made somehow."

Several years ago I made a careful study of various improvements on this form of adjustment, which had been proposed or used by tool designers, and I found that cheapness is not the only advantage which the old style has. It takes up less space than any substitute that I have yet seen, and for many uses, that is of considerable importance. It can also

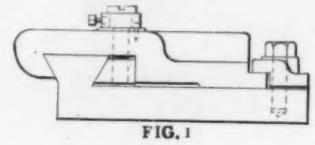


FIG. 1

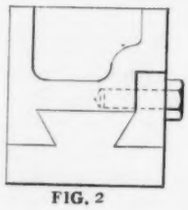


FIG. 2

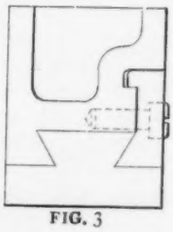


FIG. 3

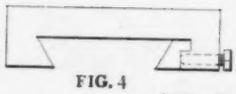


FIG. 4

American Machinist

MACHINE TOOL DETAILS.

be adjusted different amounts along the length of the gib, of which many of the improved forms will not admit.

In the amount of space required, the wedge gib which Mr. Fish favors in his design of lathe cross-slide, comes next, but it, of course, costs more and lacks the ready and universal adjustment of the old style.

Another advantage of the old style is that the sliding head can be locked by tightening a couple of the set-screws, whereas the wedge gib requires a special device for that purpose. When the sliding-head and the guides are both the same length, as advocated by Professor Sweet, the wedge gib is the best form I know of for effectiveness and space required, while the cost compares favorably with any of the other improved forms.

One serious objection to the slide shown by Mr. Fish in his Fig. 6, is that it is very difficult, if not impracticable, to make a scraped fit on that part of the cross-rail against which his gib *f* fits. I think it would be better to have a gib made similar to that shown herewith in Fig 1, which, however, was designed for a different service.

Mr. Fish favors the flat gib at *f* of his illustration particularly because, "when using a boring tool held in the tool-post, it takes the strain squarely and is much better placed than in the usual dovetail slide where the tendency to turn about *c* as a center, brings the strain anything but square with the surface which resists it at *f*." To remedy this somewhat, he suggests putting the gib on the other side at *c*, as then there is a solid surface at *f* to take the stress.

He mostly nullifies the value of this, however, at page 494, as related to gibs for holding the carriage down on the ways where he says, "I consider the gib *g* as of no value, except for locking the carriage to the bed under facing cuts. A gibbed rest is necessary for boring work fastened to the rest with a boring bar between centers, as in using a boring tool in the tool-post reaching out beyond the wings of the carriage, but I have no patience with either of these ways of doing work since the advent of boring machines. A purchaser has no right to expect a single lathe to do everything that comes into his shop." Considering all the foregoing, it looks to me as though it would be better to improve the old form of gib instead of adopting a double cross-slide at a greatly increased cost.

The gib shown herewith in Fig. 4, is suggested as an improved form of the old style, involving only a moderate increase in cost. In this the stress does not all come on the points of the screws, but is taken mainly by the hook at the top of the gib, and the points of the set-screws have a square bearing against the gib. To prevent the gib sliding out of place, one of the set-screws may have no thread on it for a short distance at the point, and fit in a shallow hole in the gib, or a dowel-pin may be used. With such a gib made thick enough and having a suitable number of set-screws to adjust it, I think it would be a somewhat difficult pattern to excel at an equal cost. The designer may, of course, put it on the side next to the headstock if preferred, but it should not be forgotten that it is often more inconvenient to get at the set-screws on that side, on account of the work in the lathe being in the way, and with as substantial a gib as this on the other side there should be no difficulty in resisting the stress from a long boring tool, if the set-screws are tightened after the tool is adjusted to the cut.

Fig. 2 shows a form of gib which I used for a cam roller carriage on which the pressure is all downward and in the direction of motion. This gib is to be held up solid against the liners and will not require adjustment. This form of slide was adopted to get a wide bearing surface in a limited space at the bottom, and it will be noted that the bearing surface, subject

to downward pressure, is wider than the guide base.

Fig. 3 shows one way this gib may be modified to suit it for a lathe cross-slide. It is shown with a liner under the gib, but this could be left out if the hook at the top of the gib bottomed in the groove. This is a good gib and not very expensive, but owing to the space required, it is not well adapted for the cross-slide of the smaller sizes of lathes.

Fig 1 shows a design of slide which has some resemblance to the Fig 6 plan shown by Mr. Fish, but I designed it for a ram or head of a special press, for which it was more suitable than any other form I could think of. It would have been better to have had the adjustment on the other side of the dovetail, but there was no room there for a sufficiently substantial gib. The flat gib at the right has liners under it to permit adjustment.

Some readers may wonder why I did not use the form of gib shown in Fig. 4 in this case, but it was not available because the dovetail could not be used in this particular case, any wider in proportion to the sliding head than that shown.

BELL CRANK.

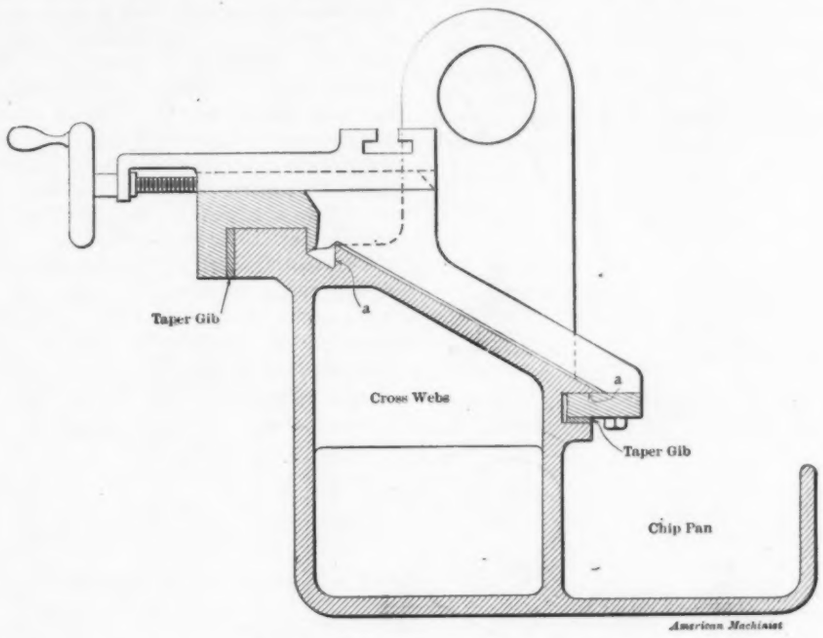
I have been very much interested in the articles on lathe design, and while many valuable points have been brought out, there are some things that seem to go on in the same old way, and I have yet to see any suggestions that tend to remedy certain evils.

Professor Sweet has repeatedly called attention to the advantages of a square box or tubular bed over the common ladder type almost universally used, and there have been some attempts to incorporate his ideas in recent tools; but the getting rid of the chips has bothered all the designers, and they have cut their beds open to let them fall through.

Another point that is as bad as it well can be, is the location of the ways where they are liberally sprinkled with chips which the carriage grinds in. If any designer would allow chips and dust to fall directly on his spindle bearings, he would be called crazy, but we hear little protest about the chips on the ways, although the truth of the ways is as important as the truth of the spindle.

In designing some machines lately, I used a form of bed which, so far as it has been tried, seems far ahead of any of the ordinary forms. The accompanying sketch shows the scheme very clearly and requires very little explanation.

The main carriage-way or guide is set considerably higher than is common, and the carriage has a very long bearing on it, long enough so that it is always covered near the cutting tools. By raising this way or guide, it is brought nearer and more in line with the cutting strains. The top of the bed is inclined sufficiently to cause the chips to slide off, about 30 degrees having been found to be right. At the rear is the other carriage-supporting way, and it will be noticed that this has bearings only at the top and bottom, with no bearing in the back of the groove at all. This being so far from the cutting strains, a short bearing is sufficient, and I have made it as long as the width of the carriage bridge, which, for a machine swinging 18 inches, I make 10 inches. The chip pan may be cast solid, as shown, or it may be left off and the chips fall to the floor. The top of the bed is solid, and is planed to provide ways for the tailstock, which is clamped in the grooves *a a*. A steady-rest may also be secured in the same way.



CROSS-SECTION OF LATHE BED AND CARRIAGE.

Another advantage of this style of bed which has developed in use is that practically all of the chips slide back instead of many falling to the floor for the operator to walk over. This is a point that I know from experience will be appreciated by every machinist.

The cross-slide bearing is the same length as the cross-slide, as advocated by Professor Sweet, and screw and handwheel travel with the slide. The headstock is cast solid with the bed.

I think these features could well be incorporated in some of the modern tools being put on the market.

W. P. HUNT.

Should a Machinist Sit While Working?

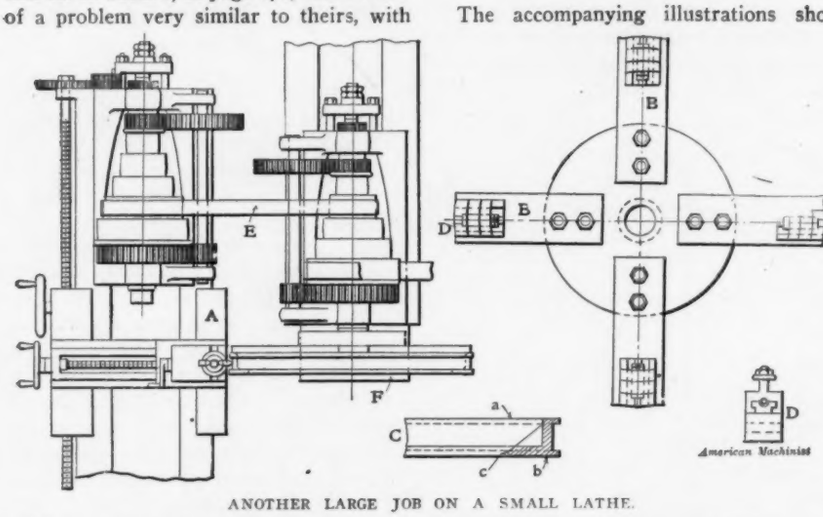
Having noticed the article at page 675, under the heading "Should a Machinist Sit while Working?" I hope (to quote the gentleman that remarked on it) that it may form "an interesting train of thought" for a good many more people here. Comparing existing conditions in America with those over here, it certainly seems novel from an English point of view to see a machinist perform his work in a sitting position. I have spent several years working in American toolrooms, and everywhere I have found that the men are provided with such small comforts as a stool and facilities to wash, and in some places even towels and soap (the same thing holds true about Germany), while here in England all such things are lacking. I have been through some shops considered good and found the same state of affairs everywhere. I came over here several months ago and am working at present for a firm situated in a suburb of London, where about 200 men are employed. If anyone wants to indulge in the comfort of sitting down to his work—which in my department is of such a nature that it is almost awkward, besides more tiring to perform in a standing position—he has to find his own stool, or make one without the consent of the foreman. This has to be done whenever a chance presents itself, which I don't think is very sound policy from the employer's standpoint, as most of the chaps have some kind of a stool on which they have spent more or less time. I myself happened to find two boxes which I nailed together and which are serving me as a stool now. It is the same with the facilities for washing; there are a number of fire pails in the shop, which, for lack of anything else, are used for washing. There are no water taps in the shops; every drop has to be fetched from the yard below. The working hours here are from 6 A. M. to 5 P. M., with a half-hour for breakfast and an hour for lunch. Most of the men stay in for breakfast and cook their own tea, although they are not supposed to use the company's gas for that purpose, yet one generally prefers to take chances.

than to crowd into a filthy breakfast room (and filthy they all are around the factories). It is the same with the water closets. There are two for one department employing 80 hands. They are situated on the other end of the yard, and the most unsanitary at that.

What I have said applies not only to one or two firms. On questioning others who have worked in different parts of the country I was told that this is the general state of affairs everywhere. J. F.

Another Large Job on a Small Lathe.

E Cooper Wills' article, at page 504, and M. L. McL.'s, at page 678, remind one of a problem very similar to theirs, with a different successful solution.



ANOTHER LARGE JOB ON A SMALL LATHE.

The shop where I was employed as foreman many years ago, was a small establishment manufacturing a line of machines for the bead industry, and doing any repair or jobbing work that came along. One day we undertook to repair an old hoisting engine, and attached a new 78-inch brake ring to its drum. We had three lathes in the place, two 28-inch swing and one smaller. How I schemed to turn the brake ring is plainly shown by the accompanying sketches.

The headstock of one of the lathes was turned so that the face-plate projected outside of the end of its bed. The other large lathe was set alongside of the first, in such a way that the cone pulleys of the two were in line, and the two beds were parallel and at such a distance that the ring would just clear the carriage *A*.

The shop had a cement floor—such as are used in southern Europe—and the two machines were fastened to it by the usual anchoring bolts and lead.

We happened to have some iron plates and four face-plate jaws. We bolted four plates *B B* on the face-plate, and on the plates we bolted the four jaws *D D*, as shown. A belt *E* connected the two cone pulleys, in order to drive the carriage *A*. The ring, whose section is shown at *C*, was chucked from the inside, the face *a* resting against the four plates. The floor had to be dug to make clearance for the ring, as shown at *F*.

The shop was run at half speed, regular tools were used for turning the ring on the outside, and a bar tool holder for facing the ring at *b*, and boring the fitting *c*. The job was done in quick time and was O. K. in every respect. The changes made on the two lathes and the cost were very light.

After that, we left the two lathes in the same position, and we had occasion, later, to use them again to turn large pieces.

J. M. MENEGUS.

Graduating Tools.

The accompanying illustrations show two tools for producing the lines when graduating micrometer disks or barrels, protractors and scales. As shown, they are designed for use in milling machines, and are clamped on the cutter-arbor and used when the spindle is made stationary by means of wedges driven between the cone pulley and the base of the machine, or by tightening the bearings.

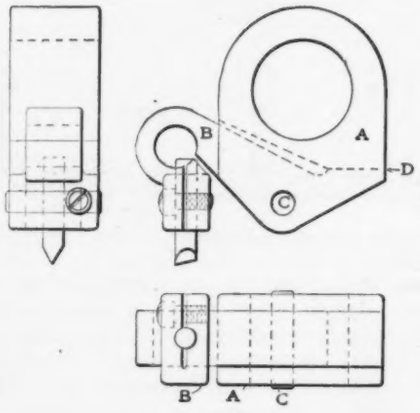


FIG. 1

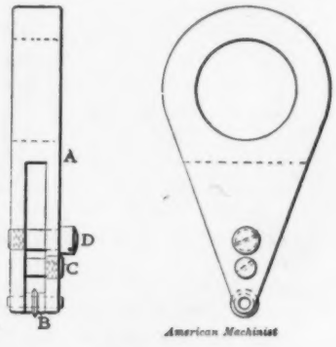


FIG. 2

GRADUATING TOOLS.

The tool shown in Fig. 1 was designed particularly for graduating pieces made of gray iron where it is essential to have clean cut lines without ragged edges, and for pieces constructed of other metals of delicate design which pressure would distort. The body *A* is made of machinery steel and is bored to fit the arbor of the milling machine, the stock around the bore being left somewhat larger than the diameter of the collars to permit rounding the corners. A groove is cut into its lower part to receive the swinging tool holder or clapper *B*, and a hole is drilled and reamed for a driving fit of the fulcrum pin *C*. The tool holder *B* is made of tool steel, and its shank is fitted to move freely but without any side play in the groove in the body *A*, and a hole is drilled and reamed for a similar fit on the fulcrum pin *C*. In its head a hole is drilled and reamed to receive the cutting tools, and a slot is cut to and beyond this hole to form the tool-holding clamp, which is tightened with a screw placed on the open slot side of the tool hole. Above and forward of this hole is drilled a hole of a larger diameter, which is met with a slot cut at an angle to form a goose-neck spring arrangement to prevent the cutting tool from hogging in or chattering. The fulcrum pin *C* is made of drill rod, and is hardened and tempered. When in action the resistance of the cut is met at *D*, and the placing of the point of the cutting tool about 60 degrees ahead of the fulcrum pin allows it to relieve itself freely when backing out.

The tool in Fig. 2 was designed for rolling the graduating lines into pieces made of machinery steel, brass or bronze, which have a construction allowing the application of pressure. On these metals it will leave a well defined line, but on gray iron it is liable to produce lines with ragged edges. The body *A* is made of machinery steel, and bored to fit an arbor on the milling machine. A deep gap is cut into it to receive the roller *B*, and to form two jaws that will yield to the strain of the adjusting and binding screws *C* and *D*. In the outer end of the jaws a hole is drilled and reamed for a driving fit of the roller pin, which is made of drill rod, and hardened and tempered. In one of the jaws, directly above the hole for the roller pin, a hole is drilled and tapped for the headless adjusting screw *C*, and above this a clearance hole is drilled for the binding screw *D* which

enters a hole drilled and tapped in the opposite jaw. By backing out the adjusting screw *C*, and tightening the screw *D*, the wear between the jaws and roller is taken up. The roller *B* is turned from octangular tool steel, the kind from which cold chisels are made, and is hardened and tempered to a dark straw color. The hole is then lapped to a running fit on the pin, and the cutting edge and sides are ground, the latter to a good fit between the jaws of the body.

H. E. R. MANBRAND.

A Multiple Stop for the Engine Lathe.

Reading E. H. Fish's articles on Lathe Design, the section at page 529, "Use of the Follow Rest," made me think, among

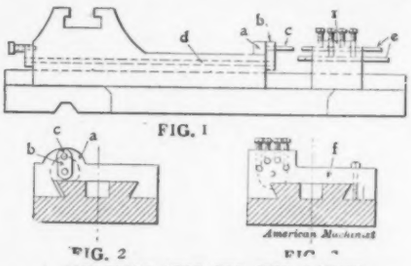


FIG. 1

FIG. 2

A MULTIPLE STOP FOR THE LATHE.

other things, of cross-slide stops. Why is it that in these days of keen competition among lathe builders and designers we do not have multiple, adjustable cross-slide stops? It seems so eminently desirable to have three or four independently adjustable stops, especially on work like Mr. Fish's Fig. 12, page 529, that it is a wonder nobody has applied that feature. Of course, we have now "in our midst" the Lo-Swing lathe, but not everybody can have that, and also, it is such a recent arrival that it does not serve as an excuse. The only thing we have hitherto had for this work is that time-honored abomination, the "apprentice boy's delight," dignified sometimes with the name of "adjustable stop for inside and outside threading." That it is as totally unfit for a stop, well, as the so-called steady-rest is for its purpose, it is hardly necessary to mention. The sketches show a multiple stop which is simple, not at all expensive, and easily adapted to lathes already in use.

Fig. 1 is a side view of the cross-slide and clamping block with stops; Fig. 2 represents the end of the cross-slide, as seen from the back of the carriage; Fig. 3 is the clamping block with the stops. The cross-slide is provided with a lug *a* for backing up the stop, which consists of a small crank *b* provided with rod *c*. The crank is fast to the small shaft *d*, extending to the front of the cross-slide, where it has a handle and spring plunger which indexes the rod *c* in alinement with the different stops, arranged on an arc with shaft *d* as a center. The clamp *f* carries the stops and has binding screws for each stop. This clamp should be stiff and substantial, so that it will "stay put," and the binding screws should be staggered to give room for the wrench.

I can see no reason why this should not be of great value in duplicate work. It is of course only for outside work, but the engine lathe is generally relieved of chucking work by a chucking lathe, where any amount of such work is done, owing to the comparative inefficiency of the single-point boring tool. The greatest usefulness of the stop would be on turning quantities of short shafts with high-speed steel, and that is precisely where it is badly needed.

There should be no difficulty in fitting the arrangement to any lathe in the shop. Of course the shaft extending to the front of the cross-slide would have to be dispensed with, and the crank *b* fitted with a spring pin to hold it in alinement with the different stops. It would not be quite so convenient to use, but ought none the less to be a valuable addition, because of the certainty of duplicating tool settings. On account of its design, it is not likely to be clogged up with chips, which is a very essential point.

H. K. HARRING.

A Fish-Line Belt.

In answer to the reader's inquiry, at page 403, Vol. 28, Part 2, regarding a fish-line belt, and referring to the reply at page 671, no doubt the conditions stated in the reply are necessary, but, after trying a belt of this kind on pulleys properly proportioned and continually having trouble with it, owing to the joint being difficult to make without a lump or knot, which caused the belt frequently to jump out of the groove at the speed at which we run a small drill for holes varying from 0.0045 to 0.011 inch diameter, we finally hit on the idea shown in the rough sketch below.

We cut rather over twice the length an ordinary belt would be, pass a single

A FISH-LINE BELT.

strand around both pulleys and then twist the remainder, as shown, around the first portion and join the ends with an ordinary double knot, which should be as small as possible. This will run perfectly, and one of the principal reasons I believe to be that no film of air can lie between the belt and pulley, as is frequently the case with very high-speed belts.

Another good point is that it can be easily tightened by taking a few more turns around the first portion, if the exact length is not secured at first.

One very necessary condition is to have the driver and driven pulleys some distance apart; for instance, we use a pair about 5 inches and 1¼ inches diameter, and these stand at approximately 2-foot centers.

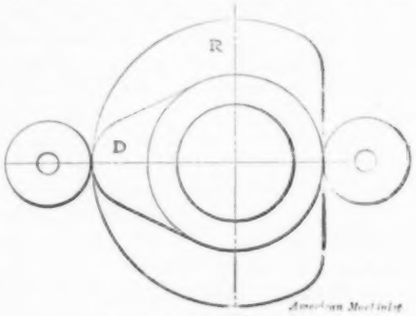
F. C. D.

The Double-Cam System.

The description, at page 503, of the double-cam system on the Monotype machine is interesting and leads me to think that the readers of the AMERICAN MACHINIST will be interested in a double cam I designed for a special press to work sheet metal.

On a squaring shear used where I am employed, there is a cam of the face-grooved type that operates the hold-down clamp, the duty on which is so severe as to cause rapid wear. To save the cost of renewing the whole cam, the part of the groove subject to the most wear was made detachable and secured in place by bolts, so as to be easily replaced.

In the special press I designed it was desirable to operate one of the die heads by a cam motion. This head was wide,



A DOUBLE-CAM SYSTEM.

with short guides and to insure a parallel motion two cams were necessary. Having in mind the experience with the cam on the shear, I decided to use two plain cams with the rollers running on the outside, to drive the head forward and a single conjugate cam between the other two, for the return motion, all on the same shaft.

The sketch shows the relative positions of the cams and rollers *D* showing the driving cams and *R* the return cam, all the rollers having a radial movement from the shaft center and the return cam roller being carried in a yoke large enough to surround the cam without touching it. The cams are plain plates the same thickness as the rollers and are secured to hubs on the shaft. The main object in this design was to get the cams as simple as possible so they would be low in first cost and cheap to renew, but it will be readily seen that the design has some of the merits of the double cams used on the Monotype, while the cost is less. The rollers run in the same direction all the time, but this plan requires at least two rollers and roller carriers. The two rollers could be carried on a single pivot lever by having the lever forked and a roller on each branch of the fork, but it would be impossible to make such a lever as light as the single roller lever used on the Monotype. Where the speed is such that the weight of the lever and rollers causes no trouble, the two-roller cam for

positive motion both ways, is far superior to any grooved face cam for durability and cost of renewal when worn out. The two conjugate cams may be milled by a method similar to the one used for the Monotype cams. When the return cam has but little work to do the roller for it may be of smaller diameter than the one for the driving cam, but the cam shape would have to be modified to suit the reduced diameter of the roller.

BELL CRANK.

The Liability of the Patternmaker.

I was very much interested in the article under the above heading by J. L. Gard at page 583. This subject is one which merits close attention by everyone in any way connected with engineering. It seems to me that to say that because a patternmaker makes a mistake he should stand all the expense to which that mistake gives rise is manifestly absurd, and if the contention is carried to its logical conclusion it may easily happen that through a small mistake a man may be plunged into utter ruin. If one insists that a patternmaker should not only alter the pattern (which is of course only right), but also replace the spoilt casting and pay for the machining which has been expended upon it, then one must go further and say that all expenses brought about through one, perhaps trivial, mistake should also be made good. If we admit so much, then, what about the foundryman who turns out a faulty casting through which several men lose their lives? Is he to pay out $2,000 or $3,000 for compensation when he probably received $20 for the casting?

In this connection an experience of my own may be interesting. The patternmaker had made the pattern for a certain part of a machine I had designed left hand instead of right, and I overlooked the mistake when checking the patterns. Incredible as it may seem, the castings were made and several of them machined, and it was not until they were passed on to the erectors that the mistake was found out. In this case nothing was said to the patternmaker, because, by checking the pattern, I had relieved him of all responsibility. Of course the other man would not see things in the same light as Mr. Gard and, if only because there always is another man, it would be well if there were some recognized rule on the subject, which would often obviate much bickering.

While I am writing to you I should like to endorse C. A. Seeger's appreciation of "Echoes from the Oil Country." I have long intended to write in the same strain myself, but perhaps it is not too late. If I lived in America nothing would please me better than to assist at a dinner given by readers of the AMERICAN MACHINIST in honor of Mr. Osborne. I only hope I shall have the pleasure of reading his contributions for many years to come.

London, England. NEMO.

Proving Addition, Subtraction, Multiplication and Division.

Having read the various articles on proving or checking multiplication appearing from time to time in the recent issues of the AMERICAN MACHINIST, especially the article by George G. Little at page 737, Vol. 28, Part 2, which appears to be the nearest approach to the method of checking multiplication in its simplest form which has appeared up to the present time, I wish to state the principle upon which the method is based, give various applications of it, and show what I consider about the simplest method of checking multiplication.

The fundamental principle upon which the following methods are based is derived from the characteristic properties of the digit figure 9. Thus, if 9 be added to any number, the sum of the digits of that number is equal to the sum of the digits of the total sum; for example:

39 $3+9=12$ $1+2=3$
9
48 $4+8=12$ $1+2=3$ $3=3$

If 9 is subtracted from any number, the sum of the digits of the minuend is equal to the sum of the digits of the remainder, for example:

39 $3+9=12$ $1+2=3$
9
$30=3$

If any number is divided by 9, the sum of the digits of the dividend is equal to the remainder, for example:

9) 39 (4 $3+9=12$ $1+2=3$
36
3

When the remainder is zero, apply the check for division, which will be given later. The above is true in all cases, and can easily be proven by trial or inspection. Having thus outlined the fundamental principles, I will give a few applications of them.

The principle underlying the checking of multiplication is dividing the multiplicand by 9, carrying the remainder only, and doing likewise to the multiplier, then multiplying the two remainders and dividing their result by 9 and carrying the remainder, which, if the multiplication was performed correctly, must equal the remainder obtained by dividing the product of the multiplication by 9. If they are not equal, a mistake has been made somewhere in the multiplication. This will hold true in all cases, barring numbers consisting of fractions or errors to the amount of 9 or a multiple thereof.

This method is a somewhat tedious operation and can be shortened, as shown by Mr. Little in his article referred to above, which also can be simplified. The simplification of his method consists in reducing the summation of the various numbers to digit figures, which is to reduce it to a number of one figure only, always less than 10. Following is an example which will show all the peculiarities of the method of checking multiplication in what seems to be its simplest form, thus:

5678 $5+6+7+8=26$ $2+6=8$
498 $4+9+8=21$ $2+1=3$
45424
51102
22712
2827644 $2+8+2+7+6+4+4=33$
$3+3=6$

Multiply the result obtained by adding the multiplicand, by the result similarly obtained from the multiplier, which is $8\times3=24$, and adding the result as before, $2+4=6$, which is equal to the sum of the digits obtained by adding together the product of the example.

A simple graphical representation of the method is shown by the cross:

The letters represent the different sums obtained in the previous example, A the sum of the digits of the multiplicand, B of the multiplier, C the sum of the digits obtained by adding the product of A and B, and D the sum of the digits of the product. If the multiplication be correct, C must always equal D; for example, substituting the figures obtained in the above example:

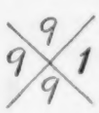
From this the method is apparent at once.

The adding can be done mentally, merely substituting the result in the cross and multiplying A and B, which will never be more than 9×9 and adding their result. The adding can be done as follows, so as not to have more than two figures:

Taking the multiplicand of the above example, $5+6=11=2$, $2+7=9$, $9+8=17=8$, always reducing to digit figures. The same process can be followed with the multiplier, etc.

The above principle can also be used in checking exact division by using it inversely, as follows:

144) 4032 (28
288
1152
1152



$A=1+4+4=9$
$B=2+8=10=1$
$C=9\times1=9$
$D=4+0+3+2=9$

This is obvious by inspection.

Addition can be proved by the same

principles, thus, having given a column of figures, proceed as follows:

56789 = 35 = 8
57432 = 21 = 3 Summation of digits
46789 = 34 = 7
51063 = 15 = 6 equals 24, = 2 + 4 = 6
212073 = 15 = 6

Sum up the digits of each number as shown to its digit, adding these (not multiplying as in multiplication and division) and then summing up the result to its digit figure, which, if the addition was done correctly, must equal the digit obtained by similarly adding the figures in the result.

This method appears superior to the method in which each number is divided through by 11, the total remainders added, and then divided by 11, the remainder of which must equal the remainder obtained by dividing the sum by 11. For example, using the same figures as above:

56789 = 7
57432 = 1 Sum equals 15
46789 = 6
51063 = 1 11) 15 (1
212073 = 4 11
4

The principle of dividing through by 11 may also be used in checking multiplication and division instead of the digit figure 9; this can be proven by trial, using the multiplication example cited above.

5678 = 2
498 = 3
2827644 = 6

Subtraction may be checked by the first of the above methods; for example:

5678 = 8 8 − 3 = 5
498 = 3
5180 = 14 = 5

The above checks will guard against many of the eccentricities of human nature in persisting in saying 3 + 3 = 9, 2 × 3 = 5 and similar absurd combinations which frequently arise. The checks will show all errors, barring the conditions imposed at the beginning, which are of very rare occurrence.

The above checks are especially valuable where accuracy of results represents dollars and cents.

Wm. F. Zimmermann.

Ball or Roller Ratchets.

In reply to the inquiry by G. C. H., at page 706, Vol. 28, Part 2, regarding such ratchets, I should like to state that, while I have never used either ball or roller ratchets in exactly the way proposed, if experience with these as free wheels for cycles is any criterion, the ball type is distinctly a failure. Four or five years ago a firm I was with had a very expensive experience in this line, for although every one was tested by fixing the central portion and applying on a lever attached to the outer ring such a weight as no cyclist could put on it, yet there were continual breakages, either of balls or outer rings, and in some cases both. The breakage usually did not occur till they had been running some little time. Both the material and workmanship were good, and the balls the best made in this country, but a very large number had to be replaced by the roller type, which was commonly in use at that time.

A small spring and plunger behind each roller seems to be necessary to insure immediate engagement, but this is not shown in the proposed design. Personally, I should try to find some other means of attaining the desired motion at the speed mentioned. F. C. D.

B——, England.

Drawings as an Element of Cost.

I am employed in the drafting department of one of the largest machine-tool works of Cincinnati, that manufacture a line of standard tools in various sizes. They also build a large line of special machines supplementary to their standard products, which involves considerable work in getting out new designs, drawings and patterns. All hands in or connected with the drafting room come under the head of non-producers in the shop accounts. I have recently had a great deal of discussion with the manager on this point. In his cost-keeping he attempts to get the net cost of production, or the actual costs of material and labor that go into the machines. When getting the cost of a special machine, the cost of designing and drawing is taken in with the shop costs, but in their standard product these are never figured in. The manager claims that in the latter case the cost of designing, drafting, etc., should no more be included to get the net cost than the pattern-maker's, the bookkeeper's, or his own time, or advertising expenses.

I cannot see why in one case the drafting and designing should be added and not in the other. To get the cost of every item that goes to make up the machine, the cost of, or value of, the design should be added, for does this not form as important a part as the material or the work or labor required to shape the same to its proper form and dimensions? Of course all the items that the manager speaks of do determine the final cost, but the machine is actually composed of the three items—material, labor and design—and these should be the items of which the cost should be found to get the actual cost of the machine which he is trying to get by leaving out the last item. The same amount of material, with the same amount of labor put on it, and worked up promiscuously into so many shafts, studs, gears and finished castings, would not bring in price much above the material value; therefore the design does form an actual part.

We see instances occurring right along where one machine of the same size is rejected in favor of another that is lighter in weight and has less parts to it, but the superior design of the latter more than compensates for the weight and parts of the former. I believe the drafting room should be placed in its true sphere as an actual production department. From personal observation I believe a great many managers are making a mistake in cutting the drafting force to the smallest possible limit, under the delusion that they are non-producers. Such methods result in designs being brought out inferior to those which might be produced if more time had been allowed and higher-priced men employed. Where machines are manufactured in large quantities the designing and drafting cost per machine is very small indeed. I would like to know what some of your readers who are up in cost-keeping have to say on this subject, and how they calculate costs in cases of this kind. W. G.

A Taper Gage.

In reply to Mr. H. K. Herring's criticism, at page 853, of my taper gage, I would like to say that the taper gage in question was designed and made by me about 18 years ago in the works of the National Meter Co. in Brooklyn, where the tool is still in use. The nature of the work in these shops required the making of many special tools and centers which were used in the engine lathes, and this gage was made to avoid the wandering about of the toolmakers to the various machines and interrupting the operators thereof in their work while trying the fit of the tapers. Hundreds of toolmakers have used the gage and each of them expressed his approval of it and wondered why nothing like it could be found in the market. H. E. R. Manbrand.

[Notwithstanding what Mr. Manbrand says above, the mathematical fact cited by Mr. Herring makes it impossible that a taper shank can lie in a V and fit it all the way along.—Ed.]

Making Corrugated Copper Gaskets.

Mr. Frauenfelder's article at page 890 criticising mine at page 679 would be justified if copper gaskets were things of precision, and if I had written of proposed machines for making them.

Since writing the article I have been told that the first machine was built by the Newport News Shipbuilding Company, and only after its utility and speed had been proven did the Navy department copy it. As a matter of fact, it does not make any difference whether the gasket is flat or not. In use it is between faces at least approximately flat and drawn together by a force more than enough to flatten the most irregular gasket.

If I had been asked to design a machine for producing these gaskets—without knowing of the method used at the Navy Yard—I would, I think, have used a drop hammer and not a punch press. I would also have tried one hard and one soft—i. e., white metal—die (the same as used in striking up jewelry), before making both dies of hard metal, i. e., steel either soft or tempered.

The machine at Newport News—one of the largest marine shops in the country—has, I understand, been giving entire satisfaction.

This fact of itself ought to be sufficient endorsement. DIXIE.

Shall We Patent Our Invention?

Every mechanic who *is* a mechanic, and nearly everyone of mechanical bent, is constantly studying to improve the methods, devices or machines by which work is done, and there is scarce one but has some more or less material conception which he considers worthy of a patent.

Such immense fortunes have been made through the medium of patents that they are often held in a degree of esteem bordering on reverence, and we are apt to think of the patent itself as being the direct source of wealth, rather than the mere shield against competition which it is; so it behooves us, before we invest sixty or more hard-earned dollars in getting a patent, to stop and consider just how the returns are to come. Contrary to the general shadowy impression, which patent attorneys are careful not to dispel, capitalists are not generally watching the *Patent Office Gazette* for a chance to invest in every untried invention reported therein, and at the cost of procuring the patent is usually a very small fraction of the amount required to get the article started on the market.

An *idea* is not patentable, but any *novel combination of parts* is, whether it be practical or not; and the Patent Office gives no information as to its practicability; hence it is obvious that the first thing to do with our bright mechanical ideas is to put them in material working form and to test their practicability. A patent gives no power. It is at best only a guarantee from Uncle Sam that no one but the patentee will have the privilege of making and vending the device covered by it; and, if no one else wishes to make such device, it is obviously useless to patent it. Having material assurance of the practicability of our invention, it is well, before proceeding to apply for a patent, to find if anyone else wants to make it and if he is willing to pay for the privilege of so doing; or, if we wish to engage in the manufacture ourselves, to learn something of the market for it.

In devising the subject of a successful patent, mechanical ability is not more essential than is good judgment as to what will sell. Once a want becomes known there are thousands of skilled mechanics ready to attempt the supply of it; and, where a thousand men, skilled in the line to which it is related, set about to supply a want, nine hundred of them will produce devices essentially similar; so the chance of anyone making a marked success is comparatively slight; but wealth and honor await the man who *foresees* a demand, supplies it, and adequately protects his device.

The fledgling inventor is apt to be chary of publicity for fear that someone will steal his ideas; but, after attempting to market a few patents, he is apt to arrive at a state of mind which would cause him to feel flattered if somebody *would* steal one. There is little danger of theft of this kind, most of the supposititious cases being simply cases of coincidence; and, while it is well to have drawings of one's device, dated and signed by two witnesses, which may be used to prove priority of invention in case of need, it is also well to know how the device strikes other, and unbiased people, before investing much in it, for the glamour of one's own invention is likely to dazzle his eyes and warp his judgment, while his intimate friends, with the best intent, are prone to flatter.

While it is well to get as many opinions as possible, seeking rather the unfavorable than the favorable, they are of use only to clarify one's own judgment, which must needs be the final basis of decision. It is well to test a thing by placing it tentatively on the market and, if people who are so ready to say "it is a good thing" evince a disposition to *buy*, there is yet ample time to procure a patent, as a thing may be on the market and in public use for two years before it becomes public property. Then, having the patent, we must be prepared to work, *work* and *pay* to lead others to see the merit so evident to us.

It is said, doubtless truthfully, that over 90 per cent. of all business enterprises fail; and, if this is true of old and tried lines, where is the occasion for surprise if 99 9-10 per cent. of the new ones do likewise? In perfect accord with the divine law of compensation, in all business where there is a possibility of gain, a risk proportionate to the prospective gain must be taken. No man can tell with any degree of certainty whether a device will sell or not, and an "expert" is about as likely to err as another, in some respects more so.

To form an opinion of value as to the selling possibilities of an entirely new device requires a broad knowledge of human nature and its needs; a knowledge likely to be somewhat cramped, in the mind of a salesman, by the limitations of the particular line with which he is engaged and the class of customers which he reaches. A hardware salesman is apt to be unable to see any possibilities in anything which is not solid and substantial, while one carrying a line of cheap jewelry would be likely to see but little merit in an improved form of stump puller.

There are probably few, if any, devices on the market to-day which have a more extensive sale than the sectional book-case; and it is told of the inventor, by one in a position to know, that, at the time of its conception, he was at work on a folding crate for the shipment of chickens; and that, after a thorough canvass and discussion, in which discussion several "experts" took part, it was decided without a dissenting voice that, while the book-case might sell to a few professional men, the market would be very limited as compared with that of the chicken crate, so it had better await the completion of that device—and wait it did. The sales of the chicken crate possibly reached a dozen (if memory serves, most of those were returned), while the sales of the book-case have been beyond estimate and are still growing.

Things which the most perspicacious business men think will have a large sale are often found to meet with no favor whatever, while things at which they laugh, as ridiculous, sometimes have phenomenal sales. No one can tell until he tries. If he fails, he has the satisfaction of feeling that he has evolved something from his own brain of which future generations may make use, and his name is at least permanently enrolled among many which are great—more permanently recorded than if it were inscribed on a tablet in the Hall of Fame; and, too, it is an open question if he who tries and fails, and tries again, is not entitled to more credit than are many of those who succeed; as to the cash returns, that's different. W. D. GRAVES.

The Suggestion Box.

Recent articles that have appeared in the AMERICAN MACHINIST regarding the advance in price of machine tools suggests the question: Why do not manufacturers try giving premiums for valuable suggestions? The National Cash Register Company gives this opportunity to its employees, and good results have been obtained by it, but I know of no machine-tool company that is following the example. Some time ago the advertising department of a machine-tool company offered prizes for the best suggestions in the line of advertising, and the plan seems to have proven very satisfactory, though but few of the employees of that concern know anything about advertising. Perhaps a greater number would have competed had it been a mechanical proposition.

I know personally of men with valuable ideas who, though willing to give them without remuneration, cannot do so because they are not fully authorized. Apparently, anybody with a good idea is welcome to express it, but one soon finds the

contrary to be the case. A man must needs go to his foreman or immediate superior with his suggestion, or infringe on the fundamental laws of management. His superior, occupied with his own affairs, does not carry the matter any further. Foremen cannot stop to consider everything that their men suggest; if they did, they could not attend to their duties. For this reason a man can seldom make suggestions to his employer, because he has no authority for so doing. Perhaps I should have said, because he has no way of doing it. Why the managing departments of such corporations do not facilitate this matter and give their men an opportunity to make suggestions is a puzzle. It seems that with some restrictions, and a fixed time between the meeting of examiners, the directors would experience little or no trouble. For instance, every three or four months a board might meet to examine the accumulated matter. The character of the suggestions could also be limited, and if the concern were builders and not manufacturers they could eliminate jigs, fixtures, etc. They could also classify suggestions into those relating to the improvement of a machine, and those relating to simplifying and reducing its cost. They could also fix a basis for adjusting premiums. Suppose that an idea is accepted by which a saving of $100 per machine is obtained, and they build 100 such machines in one year; a plan of adjusting the premium could be based on this result. The benefit would be mutual, and it seems only just that the suggester be remunerated by a share of the profits.

INQUIRER.

A Loose Thrust Block.

It is of course generally known that one length of shafting in a ship, usually next to the low-pressure crank, has several collars, and a thrust block to fit is secured by a number of bolts and nuts passing through oval holes to the ship's framing. This bearing, which transmits the propelling force to the vessel, usually has a cotter to set the engines back when the thrust of the propeller has worn the babbitting on the horseshoe collars and thrown the engines out of line.

A steamer doing regular service between London and New Zealand *via* the Cape had a most unusual experience—so far as I know without parallel. We had taken coal at Teneriffe and were on the straight start for Capetown when it took place. Until a day or so after leaving her coaling port the old "coffee mill" had acted in a satisfactory fashion, running cool and sweet on each watch, nothing peculiar being noticed anywhere.

One night, the hour when graveyards yawn, 12 midnight came around and with it Mac, the Third; the Fourth, relieved of his watch, sought his bunk and for an hour all went well. About 1 A. M. things began to crowd a bit; bearing after bearing started to warm up; bottom ends, top ends, quite suddenly started to get—as Mac phrased it—"red shrinking hot." Sending up for the Chief, Mac closed the throttle and brought the engines up.

It speaks badly for our engineering skill that five whole minutes were wasted before the cause of the mischief was apparent. The forward crank webs of each engine were hard on the cheek of each main bearing and, on examining the thrust, this was found to be ¾ inch or the total available distance of the oval holes forward from its ordinary position. The next query was to get it back. A 4,000 horse-power triple engine crankshaft with tunnel shafting 13 inches diameter to be moved ¾ inch is no joke. We talked first of making wedges to drive between the crank webs and engine framing. The Chief said "he could put up a prayer for a 50-ton hydraulic jack." But the Second (good man) had been thinking. "I've got it," he shouted, and made for the throttle. The Chief stopped him with an oath, but when he explained his idea the Chief caught on at once. "Reverse the engines; the propeller will then exert a pull instead of a thrust and so put the block back in its place."

It didn't take long to adjust the after-packing piece of the block and, with the Second on one side and Mac on the other watching, the Chief reversed the engines dead slow. It took three or four revolutions before the thrust began to move, and then a thud, the slack nuts were tightened up, the cotter at the forward end adjusted, and we were again inside of 40 minutes.

London, Eng. A. L. HAAS.

Treatment Of Apprentices.

There have been many articles in the AMERICAN MACHINIST concerning the treatment of apprentices by their employers. There is another thing, in many ways quite as important, and that is, the treatment they receive from their fellow employees. Often the apprentice when starting to "serve his time" is placed under the direct charge of journeymen who are proficient in their several lines of work, and the influence which these men exert over him is very powerful. He will go to them with questions, no doubt many of them seeming foolish or simple to trained mechanics, and they will ridicule them. Nothing seems to dampen a boy's ardor as much as ridicule. The boy is less liable after to ask questions and therefore he does not learn so fast. If he is sensitive and takes it to heart, woe betide him, for then the journeymen will have their fun. Almost every one will start "joshing" the poor fellow. Upon speaking to some of the men about this at one time, I was informed that it would do the boy in question good, that he might as well get his knocks now as any time and that they themselves had been through it. No doubt they had; I myself passed through the ordeal, but that is no reason why all apprentices should suffer, as indeed they do. The boy's task is hard enough without having his fellow workmen make it any harder.

Another matter, and this is the principal one, is the question of education. Why have so many machinists and toolmakers an aversion to education? Time and again have I heard apprentices called ——— fools for wasting their time studying, and this by good workmen too. These same machinists will argue against technical papers simply because something which a contributor has described for the interest of the craft may have been familiar to them (because of their experience) for years. Many of the apprentices are thus influenced against studying; wasting their time, as some of the men call it. A number of men when questioned, stated that they never studied geometry, algebra or trigonometry and that they managed to "get along" all right. On the other hand a short time ago I heard a journeyman, a first-class man, bewailing the fact that his education was neglected. He had good reason for this, because his unwillingness to study cost him a foremanship. Perhaps he will now advise the boys to devote a few hours every week to study. Some of the boys have the sense and determination to study, regardless of the opinion of the men. I have noticed that these are the ones who are able to come out on top.

I have also noticed that the apprentices in regular machine shops are better treated by the journeymen than are those in the machine departments of manufacturing concerns. Perhaps the business methods or systems may account for this. In one shop some of the journeymen even refused to wash up at the same sink with the apprentices. Why not accept the boys as equals at least; in many cases they are the superiors of the men in morals and intellect.

SQUARE DEAL.

A builder in Pennsylvania, having heard that the men did not start work at the proper time, thought he would drop down about 6.30 one morning and see. Going up to the yard he caught sight of a joiner standing smoking, with his kit not even opened. Simply asking his name, which he found to be Jake Robertson, he called him into the office, and handing him four days' pay told him to leave at once.

After having seen the man clear of the yard, he went up to the foreman and told him he had made an example of Jake Robertson by paying him off for not starting to work at the proper hour.

"Jumping Jupiter," ejaculated the foreman, "that chap was only looking for a job."—*N. Y. World.*

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST Co., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

During 1905 *the* AMERICAN MACHINIST *printed and circulated* 1,059,100 *copies, an average of* 20,367 *per issue. Of this issue* 17,750 *copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.*

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The Contest of the Currents.

In later decades, when the operation of main lines of railroad by electricity shall have become common, as many people believe will ultimately come to pass; when the railroad machinist will see the near approach of the time when he will have no more cylinders to bore, no more guides to line up, no more valves to set, one of the remembered incidents in the history of the development of electric traction will doubtless be the present controversy between the advocates of the direct-current system and those who contend that the alternating-current system has reached sufficient maturity to justify its application at the present time; this controversy having followed the publication of Mr. Sprague's objections (referred to at page 634, Vol. 28, Part 2) to the adoption in a certain instance of the a. c. system.

The most specific replies to the objections raised by Mr. Sprague appear to be contained in some letters, recently published in the *Railroad Gazette*, from George Westinghouse and B. G. Lamme, of the Westinghouse Electric and Manufacturing Company, which company has the contract for the equipment of the New Haven road. Some of the statements previously made have been pretty general, —qualitative rather than quantitative—but in this later correspondence comparative figures of cost, speeds, times, and power consumed for the systems are given, showing the superiority of the single-phase system from the standpoint of first cost, and that, though the single-phase locomotive may take, in a typical run, more power at the low speeds, yet the power at the higher speeds is less, so that the average amount of energy per ton-mile is the same for both locomotives.

It is stated that there will be no difficulty with the operation of the New Haven locomotives on the New York Central d. c. line, because they have really a high-class d. c. equipment adapted for operation on alternating current as well. As to the facility of control of the a. c. motors, it is pointed out that the conditions are very satisfactory, since they can be regulated for speed by a more economical method than that customary with d. c. motors, where, except at two or three controller positions, current is wasted flowing through resistances. With the single-phase locomotive the power is proportional to the work to be done, and moreover it is not limited in maximum speed by the potential at the conductor, as is the d. c. machine.

It is declared that the equipment is not necessarily restricted to locomotives, as the Westinghouse company is prepared to equip cars on the multiple-unit system, getting over the control difficulty by using the electro-*pneumatic* system instead of the older system by which the master-controller operates the controlling mechanism on each of the motor cars through the medium of an auxiliary electric circuit. No difficulty need be experienced in changing from the a. c. line to the d. c., as this can even be done while running fast.

Though the order calls for 25 single-phase locomotives, the railroad company is not obliged to accept them unless a test made on one of them shows that they will work successfully. The first one has recently been delivered by the Baldwin Locomotive Works to the Westinghouse people at Pittsburg in order to receive its electrical equipment. It is well-known that the New York Central locomotive contains some very original features in its motor design, and it has been implied that really this machine is a greater departure from standard practice than the new a. c. locomotive, and that, therefore, the large amount of time which has been devoted to experimenting with the former is quite unnecessary with the proposed New Haven equipment.

The saving due to higher potential being incontrovertible, Mr. Sprague has come forward with a boost for direct-current in the shape of a declaration that it is quite feasible to employ a much higher potential than the common 500 or 600 volts, and he states that he is prepared to engineer successfully, should anyone so desire, a d. c. installation using an e. m. f. of 1500 volts, even though a third rail be employed as the working conductor. In this connection it is interesting to note that a description has been published of 1500 volts d. c. motors for an electric road which is under construction in Switzerland. But although this is a high potential for d. c. operation, the possibilities of alternating current reach far beyond that.

Mr. Westinghouse, whose timely caution a few years ago about the terrible possibilities of fire and the consequent necessity for using fire-proof materials in cars intended for electrical propulsion through tunnels set many critical tongues to wagging, but whose advice is, all the same, now being universally followed, has introduced another element into the discussion, viz., the nuisance of electrolysis which accompanies the use of third rails, conveying direct current. Mr. Westinghouse did not say in his letter to our contemporary, as might be imagined from the scare headline in a daily paper, that our elevated and subway structures were likely to crumble like a house of cards, but he did emphasize the very serious evil which is continually going on due to the current on the negative side of the circuit traversing lines of pipe, metal work, etc., in the neighborhood of the railway, and called attention to the absence of this effect being another advantage of alternating current.

If the champions of the single-phase alternating current make good their claims, right here in the metropolis of America, it will be an achievement of much significance.

Houghton, Mifflin & Co., of New York, send us a pamphlet which is Chapter II of the "Liquor Problem, a Summary of Investigations Conducted by the Committee of Fifty." This particular chapter is entitled "The Physiological Aspects of the Liquor Problem," and has been prepared by Dr. John S. Billings, chairman of the committee referred to. If this chapter is an indication of the general value of the work, we should say it is one which ought to be in the hands of every person who is in any way concerned with what is known as the "liquor problem." The subject is treated in a manner which for its evident familiarity with the subject, its wholesome sanity and its fairness, is remarkable and which commands the respect of the reader. Many of the popular notions regarding alcohol are shown to be fallacious, and one of these is the idea, which is quite prevalent, that most of the injury which comes from whisky drinking arises from the fact that whisky "nowadays" is too often adulterated with injurious chemicals. Dr. Billings declares this to be untrue, and that most of the adulterants used in the cheaper whiskies consist simply of water and non-injurious coloring matter. It is the alcohol which is to be considered, and the question of when it is especially injurious or undesirable, and when not so much so, is here intelligently and thoroughly discussed by an expert. Both those who drink and those who think no one is ever under any circumstances justified in doing so should read this chapter. The general conclusion taught by it is that alcoholic drinks are not needed by young and healthy persons, but are apt to be dangerous to them. That when taken it should be only with food and preferably with the last meal of the day. That such drinks of all kinds are worse than useless to prevent fatigue or the effects of cold, though they may at times be useful as restoratives after the work is done; that alcoholic drinks are almost always a useless expense; that their excessive use is the cause of much disease, suffering and poverty, and of many crimes, but that such excessive use is sometimes the result, rather than the cause, of disease.

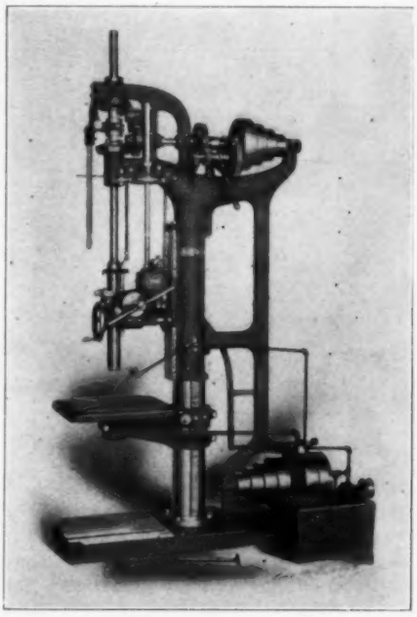
The *Bicycling World* tells of a new and inquisitive motorcycle rider who had to see what the "insides" of his machine were like, and who found each of the piston packing rings "broken." He thereupon wrote to the manufacturer demanding a new set of rings free of charge, pointing out that as each ring was broken in exactly the same place, in exactly the same way, it was proof positive of defective material. This man could scarcely have had any idea what the rings were for, the uselessness of an unbroken ring being so evident.

New Tools and Machine Shop Appliances.

AN UPRIGHT DRILLING AND TAPPING MACHINE.

The half-tone shows a heavy pattern upright drilling and tapping machine.

This machine has a square oil grooved table connected with necessary piping and pump to convey lubricant from the reservoir shown, to the drill and back again



AN UPRIGHT DRILLLING AND TAPPING MACHINE.

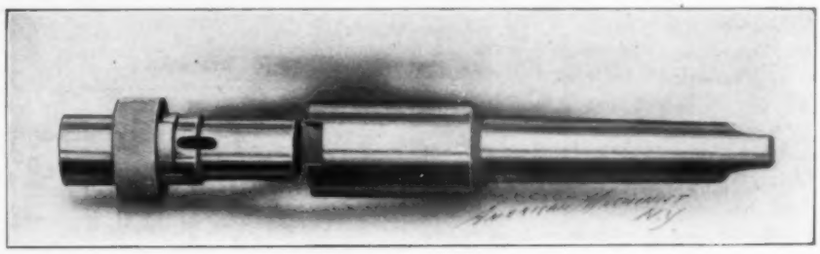
to the tank. This arrangement works well and can be supplied on any size or number of machines.

In addition to the geared tapping attachment located directly on the spindle, this machine is also equipped with positive geared feed located directly on the sliding head, where it is always in control and full view of the operator.

It is built by the Cincinnati Machine Tool Co., Cincinnati, Ohio.

"DOUBLE QUICK" DRILL CHUCK.

This tool consists of a chuck or socket which fits the drill press spindle, and a collet which may be slipped into place in the chuck when the machine is running by simply pushing up on the loose nurled collar, or removed by pulling the collar down.

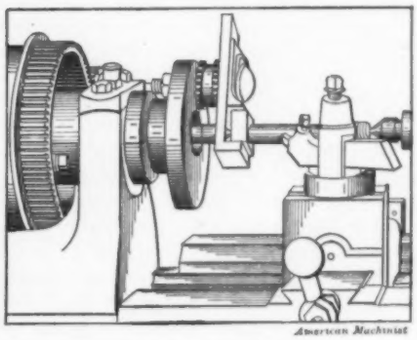


"DOUBLE QUICK" DRILL CHUCK.

The collet consists of the nurled collar, a latch and a drill socket. It has a slot which admits the latch, also a spring which lets the latch fly in or out of a retaining groove formed in the chuck. When the collar is drawn down it throws the latch back, releasing the collet from the chuck. The two lugs, one on each side, which fit into the slots in the chuck, do the driving. A friction chuck is also made to save drills and taps; this is operated in the same manner as the positive one shown. The maker is the Byer-Humrichouse Tool Company, Hagerstown, Md.

A BOLT DRIVER.

The illustration shows a driver to be used while turning bolts. The back of the driver is slotted so that the center can enter the center hole in the bolt



A BOLT DRIVER.

head. The jaws are adjustable for various sized heads, and may be set to or from the face plate by manipulating the adjustable washer. This driver is made by Armstrong Bros. Tool Co., Chicago.

New Publications.

"Practical Pattern Making," by F. W. Barrows, 326 5 x 7 inch pages with 141 illustrations. Norman W. Henley Publishing Company, New York. Price $2.00.

The pattern maker will find in this book illustrations of the leading operations in his craft, followed by detailed descriptions of the methods followed in making a considerable number of representative patterns. An up-to-date feature is the illustration of methods of making patterns for use in molding machines. The book concludes with a section on the cost

of patterns, together with methods of making, recording and inventorying them.

"Machine Shop Tools and Methods," third edition, by W. S. Leonard, 554 6x9 inch pages with 689 illustrations. John Wiley and Sons, New York; Chapman and Hall, Limited, London; price $4.00.

"Machine Tools and workshop Practice," by Alfred Parr, 444 5½ x 8½ inch pages, with 510 illustrations. Longmans, Green and Company, London, New York and Bombay.

These two books have essentially the same purpose—the instruction of engineering students in the essential features of the design of machine tools and in the methods of their use. The former is intended for the students of the Michigan Agricultural College and the latter for those of University College, Nottingham, England. Both describe the leading types of machine tools with a good deal of fullness and give a comprehensive view of the classes of work to which they are adapted, together with the methods of chucking, handling, etc. Neither makes much attempt to cover the refinements of workshop practice, the methods shown being the every-day methods of the shop, including a good degree of attention to manufacturing methods. In one particular the English book is the more comprehensive, as it gives numerous illustrations of both English and American tools, while the American book is confined to American tools. Thus in the English book we find the Flat Turret, the Gisholt and the Alfred Herbert turret lathes side by side. Most of the machines shown are, of course, of English make, a fact which makes the book of large interest to American machine tool designers. The needs of the apprentice are, of course, much the same as those of the engineering student, and to the American apprentice Mr. Leonard's book can be warmly recommended, as can Mr. Parr's to the English apprentice, the chief dedeficiency of both being, perhaps, in their presentation of grinding machines and methods in which neither are up to date. Of other things, however, the apprentice will find in either book a mass of information of the kind he needs and wants without knowing where to go to find it.

"An Elementary Text Book of Theoretical Mechanics," by Geo. A. Merrill, 267 5½ x 8 inch pages with 168 illustrations. The American Book Company, New York, Cincinnati and Chicago.

This book is intended as a text book for upper classes in secondary schools and the two lower classes in colleges. It is intended to present the subject of Mechanics more fully than is possible in the limited number of pages available in a general text book on Physics, but still in an elementary manner. It is strictly rigorous and correct in its presentation of the fundamental concepts of the science and draws many if its illustrations from the events of every-day life. Many problems are included for solution by the student, but the mathematics involved is simple, as nothing beyond plain trigonometry is involved.

Spinning Lathe.

The accompanying engravings illustrate a spinning lathe which is made in a number of sizes by the Good Manufacturing Company, Chicago, Ill. As shown in Fig.

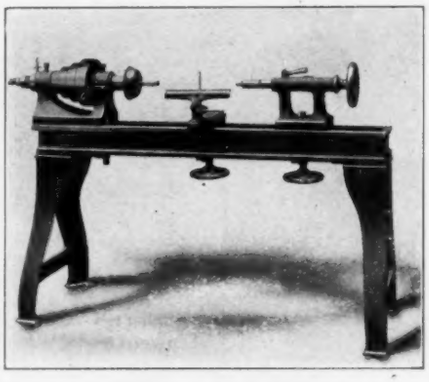


FIG. I. A 15-INCH SPINNING LATHE.

1, the headstock of this lathe is cast in one piece without removable caps, the brass boxes being fitted in place in the manner shown in Fig. 2; the double cone construction permitting adjustment for wear in the bearings to be readily made. The front cone is in one piece with the spindle, the rear one, which is a sliding fit on the reduced portion of the spindle, being prevented from turning on the lathe by a feather. The nut *a*, which takes up the spindle play, is operated by adjusting pin *b*, which is inserted through a hole in case *c*; the nut is slit and has a small screw which, when adjusted, determines the tightness with which the nut turns upon the spindle.

To take the end thrust in heavy spinning work a roller bearing is provided, which consists of a hardened tool-steel step inserted in the end of the spindle and working against a pair of hardened tool-steel rollers, which in turn bear against a hard disk which can be adjusted in its position by means of the screw *d*. The rollers are retained by a brass cage (drawn to larger scale at *e*), and are made with conical ends to reduce friction with the walls of the cage.

The cone pulley is made in two parts, the larger section having a taper hub, which is slit at four points, and fits a taper bore in the smaller cone. The two sections are drawn tightly together, and thus clamped to the spindle, by means of a pair of cap screws.

In order to provide a quick release for the screw handle which holds the stock to be operated upon in the lathe, a device is placed in the forward end of the spindle consisting of a sleeve *f* and a spring split-nut *g*, the hole being closed by the plug *h*, which has a small opening of sufficient size to admit the stock-holding screw. The sleeve *f* is pressed outward by the spring at the rear, thus keeping the split nut normally closed; when, however, the handle *i* is shifted, the collar *j* is drawn back and through the connecting pin slides back the sleeve, and allows the split-nut to open and release the screw-handle, when it can be at once withdrawn. This device allows a piece of finished work to be removed from the lathe and a new blank to be inserted without stopping the machine. Fig. 3 shows the details of this

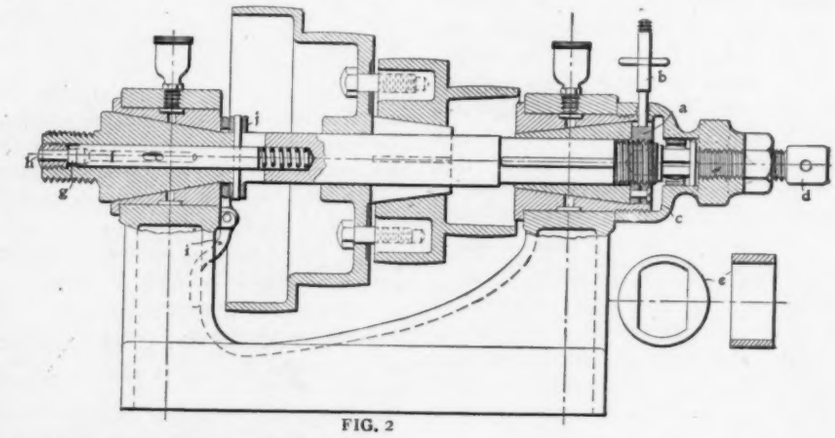


FIG. 2

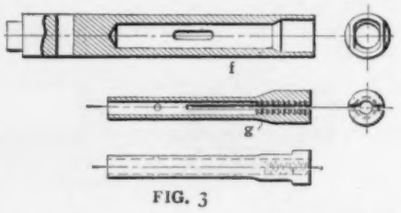


FIG. 3

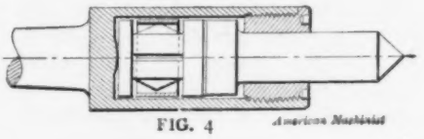


FIG. 4

HEAD STOCK OF SPINNING LATHE.

releasing device; the piece *g* is made of steel and case-hardened, and the stock-holding screws also are hardened.

Fig. 4 shows a section of a roller-bearing center. The body is bored to receive a roller cage and a pressure plate similar to those used in the spindle thrust bearing. The large end of the center presses directly against the rollers. The bore of the casing is closed by means of a plug, which is tightened by a spanner wrench, and through which the center passes freely.

Hydraulic Spring-Testing Machine.

We illustrate herewith a hydraulic spring-testing machine, which includes a device for giving an autographic record of the deflection of the spring corresponding to the gradually increasing loads put upon it. Fig. 1, which shows an earlier design by the same manufacturers, is presented because it shows very clearly the method of applying the load to a semi-elliptic spring, in addition to permitting the progress attained in the later design, illustrated in Fig. 2, to be seen.

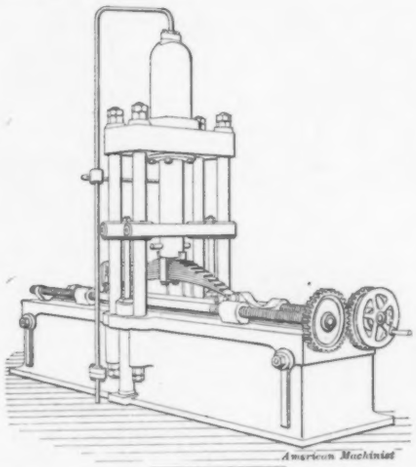


FIG. 1. OLDER MODEL OF SPRING-TESTING MACHINE.

In the illustration of the latter, *A* indicates the bed of the machine. This bed encloses the levers and other mechanical parts of a weighing machine, the table of which is formed by the part *B* and is provided with guides for the wheels of the carriages which support the spring to be tested. The large steelyard with its counterweight is indicated by the letter *C* and the small steelyard by *D*. The latter is used to balance the weight of the spring and the carriages before beginning the test. In this way the reading of the large steelyard always represents exactly the load supported by the spring. The weight *E* serves to adjust the machine.

The movement of the counterweight on the large steelyard is regulated by the screws *F* and gears *G*, the large wheel of which is provided with a handle and is operated by hand.

The valve *H* is of special construction and guarantees a control of great exactitude over the movement of the large ram *T* and of the crosshead used to load the spring. The cylinder *K*, wrapped with a sheet of paper, constitutes the automatic register. It is put in motion, by means of the small shaft *L*, by the movement of the counterweight. The piece *M*, provided with a pencil, is driven in a vertical direction by the movement of the large ram. The movement of the counterweight *O*. The large ram and its crosshead are raised afresh by means of two small rams *P* placed side by side. The form of the carriages necessarily varies with the type of spring that is to be tested.

This machine, which is capable of exerting a pressure of 5,500 pounds on a spring, is made by the West Hydraulic Engineering Company, of Luton, Bedfs., England.

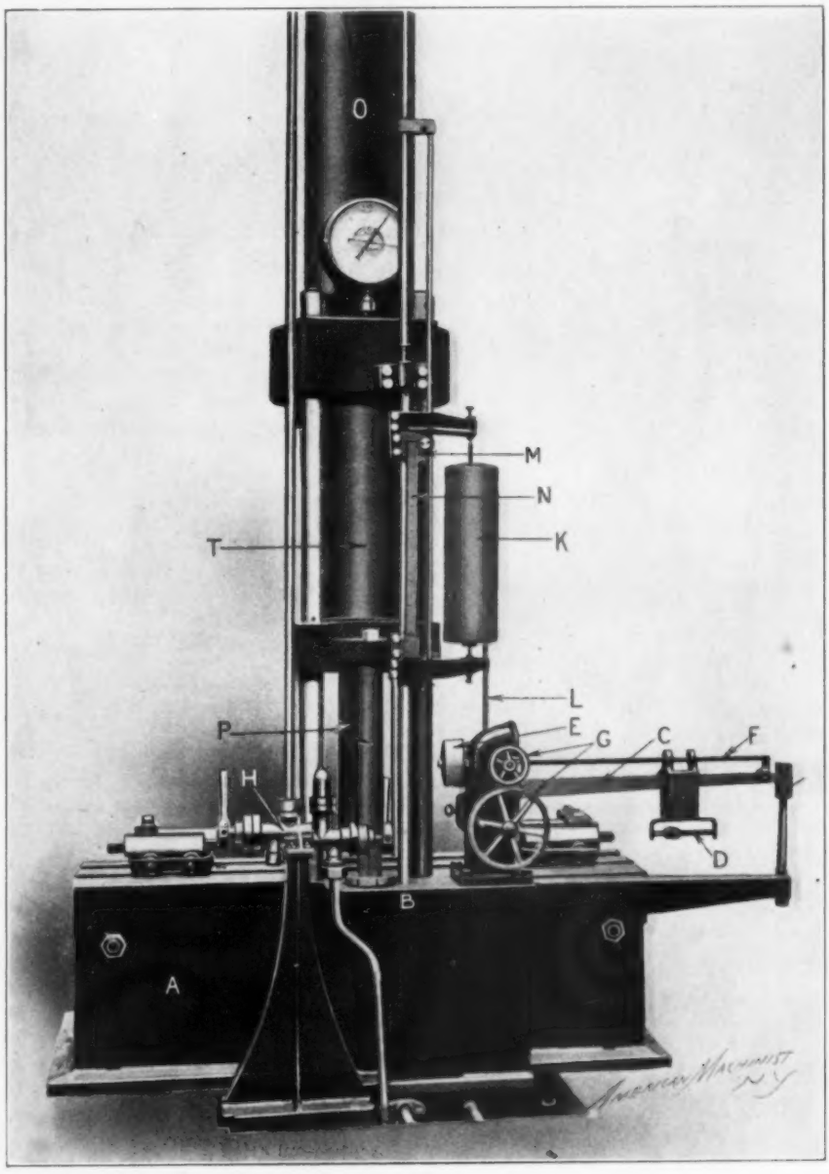


FIG. 2. SPRING-TESTING MACHINE WITH RECORDING MECHANISM.

should always be in proportion to the increase of load supported by the spring, so that the large steelyard is always balanced. The pencil then traces on the paper a curve indicating at each moment the bending of the spring and the load required for this flexure. The scale *N* indicates the total bending. It is adjustable, so that a start may always be made at zero. A manometer indicates the total pressure per unit produced in the cylinder

A Locomotive that Moved by Itself.

In a certain locomotive works that shall be nameless, a passenger engine of the usual build turned out there was completed ready for a run to the painting shed some distance down the line from the shops. Two apprentices who had assisted to build her remained in the cab when she was towed down to be painted; as lads of a certain age will, they had a monkey

fit on, opened the throttle and put the reversing lever over as if driving.

The engine arrived all right, was shunted on to the siding and into the shop, to be left for the necessary toilet without which no self-respecting locomotive cares to be seen, the boys remaining aboard after the shunter was uncoupled;—one of them put the lever over and opened the throttle again, when to their undisguised amazement, the engine began to move and came to rest just off the main line. The authors of the mischief, thoroughly frightened, decamped, while the paint shop foreman turned around, to find the engine so recently placed under his charge out on the siding.

In relating the incident to me in tones of awe he said, "I stood dumbstruck and open-mouthed and even forgot to swear." And to this day he believes firmly in spooks and uncanny things; quoting the engine that moved by itself as an instance of supernatural agency.

It is well known that a locomotive under certain conditions becomes a powerful air pump; the boiler in the above instance had a pressure of air put in on the run down, and this was used as a propelling force when the throttle was again opened. Had the reversing lever been put to reverse position under the above conditions, the boiler would have been exhausted of air and so there would have been much the same effect only in a less degree.

London, England. A. L. Haas.

When it comes to making a New Year resolution, every man should resolve to make some effort toward developing some new idea or some new line of thought in the beginning of the year.

The standing committee on applied arts of the American Institute of Architects, at a recent meeting in Washington, passed a resolution favoring the adoption of the metric system.

The Quarterly Journal of the Ohio Mechanics Institute, Cincinnati, contains, among other things, a paper entitled "Trade Journals and Their Educational Value," by Warren C. Rude, which was prepared by Mr. Rude as a graduation essay. Mr. Rude takes for his example of a modern technical journal, the American Machinist, and says some complimentary things about it, for which naturally he has our thanks.

Personal.

C. B. Richards, formerly with the Acme Machinery Co., the Cleveland Pneumatic Tool Co., and more recently with the Canada Machinery Co., has associated himself with the Cleveland office of Dravo, Doyle & Co., New England Bldg.

Richard L. Thomas having become second vice-president of the B. M. Jones & Co., Inc., Boston and New York, has severed his connection with the National Lock Washer Co., of Newark, N. J., and will devote his entire energies to his new position.

George F. Maddock has resigned the position of general superintendent of the works of the A. L. Ide & Sons Company at Springfield, Ill., to open a general engineering office in Chicago in connection with the firm of Maddock, Bates & Company, 824 Marquette Building.

William A. Asplund, who has been with the American Woodworking Machine Company, of Norwich, Connecticut, for the past seven years as a machinist, has left the company to accept a position as assistant superintendent of the Beach-Russ Company's factory at Long Island City, N. Y.

C. C. Tyler, who, some years ago, was prominently identified with the Pratt & Whitney Co., was afterward with the Westinghouse Electric and Mfg. Co., and latterly General Superintendent of the Milwaukee works of the Allis-Chalmers Co., has resigned that position to become Manager of Works of the National Cash Register Co. at Dayton.

Obituary.

Robert R. Stannard president of the Blake & Johnson Manufacturing Company, died suddenly of cerebral hemorrhage at his home, in Waterbury, Conn., January 4, fifty-eight years old.

Jacob H. Hills, superintendent of the Haydenville Co., Haydenville, Mass, died suddenly of pneumonia December 24, aged fifty years. Mr. Hills was formerly located in Lorain, Ohio. He was highly spoken of by his associates.

Judge John R. Daggers of Paterson, N. J., died at his home in that city Jan. 6. He was 87 years old,and came to this country from Preston, England, seventy-one years ago. For several years he worked in the Rogers Locomotive shops in Paterson, and then became a special agent for the company in the South. In 1858 he purchased an interest in the bobbin manufactory of Scull & Co., and later became sole owner. A year ago he gave up active business. He was appointed a lay judge in the 70's.

Dr. Otto A. Moses, who founded the Hebrew Technical Institute in Stuyvesant street, New York city, for the free scientific education of poor Hebrew boys, died at 72 West 35th Street, January 3. He was born in Charleston, S. C., in 1846. He took a scientific course at the University of Liepsic, and on his return to this country he began business as a mechanical engineer and electrical expert. For several years he represented Edison in Paris, and was largely instrumental in introducing the Edison inventions in Europe. In the seventies, previous to his removal to this city, he was State Geologist of South Carolina.

Business Items.

The Otto Konigslow Manufacturing Company, Cleveland, Ohio, has opened a new factory with greatly enlarged facilities and is prepared to do stamping, die work, special machinery and manufacturing.

The Buffalo Forge Company, Buffalo, N. Y., has recently completed the installation of the heating and ventilating apparatus for the large plant and garage of the London Power Omnibus Co., London, England. Frequent mention of the completeness and success of their apparatus has been made in the English papers.

The new Robb-Mumford Boiler Works of South Framingham, Mass., have installed four Electric Northern traveling cranes and riveter hoists manufactured by Northern Engineering Works, Detroit. One of 25 tons capacity 50 ft. span 4 motor design; one 5 tons 28 ft. span 3 motor; and two electric riveter cranes of 20 and 15 tons capacity with fifty foot lift.

The Motch and Merryweather Machinery Co., Cleveland, Ohio, have opened a branch office in Cincinnati, in the First National Bank building, to be in charge of Mr. L. H. Mesker, formerly general sales agent of the Allentown Rolling Mills Co., Allentown, Pa., and previously superintendent of the Gas Machinery Co., Cleveland, and general foreman of the McBeth Iron Co., Cleveland.

The Ingersoll-Rand Company announce that they have secured exclusive control of the product of the Imperial Pneumatic Tool Company, with shops at Athens, Pa. The line of Imperial tools is well known and complete, including pneumatic hammers, drills, riveters, reamers, hoists and plug drills. The Ingersoll-Rand Company are manufacturers also of the Haeseler pneumatic tools and the public is now offered the choice of these two distinct lines of tools of established merit.

The Kempsmith Mfg. Co., Milwaukee, Wis., on account of excessive demand for their new improved types of milling machines, is adding thousands of dollars worth of new equipment in their shops, and is rapidly pushing work on a two story addition, 75x45. They are also installing a new Corliss engine which will give double their former power capacity.

Owing to constantly increasing business the Blaisdell Machinery Company, of Bradford, Pa., has opened sales office at 120 Liberty St., New York ,and 707 and 708 Lincoln Trust Building, St. Louis, Mo. The St. Louis office is in charge of J. A. Prescott, Southern manager and the New York office in charge of A. H. Valiquette.

Manufacturers.

The Scranton, (Pa.) Axle Works will erect an addition to its plant.

The Williamette Boiler Works, Portland, Ore., will build a new factory.

The Consolidated Pipe Company, Los Angeles, Cal., will put up a new plant.

An addition is being built to the foundry of Parker & Tapping, Brainerd, Minn.

The George N. Pierce Automobile Company, Buffalo, N. Y. will enlarge its plant.

The Gilbert Clock Company, Winsted, Conn. will build a five-story addition to its plant.

The Ohio Central Railway Company will build several new shop buildings at Bucyrus, Ohio.

The Firth-Sterling Steel Company of McKeesport, Pa., will move its plant to Glesboro Point, D. C.

The Gardner Governor Company, Quincy, Ill., will establish branch molding shops in La Grange, Mo.

The Anniston, Ala., plant of the Western Steel Car and Foundry Company will be doubled in size.

The New Century Gate and Fence Company has been organized at Denison, Tex. Edwin Clark, president.

Burdick & Son, Albany, N. Y., tin plate specialty manufacturers, are to construct a four story addition.

The Security Building Company, Cincinnati, Ohio, newly incorporated, may erect a $300,000 power plant.

The Olympic Foundry Company, Seattle, Wash., will move to Georgetown, where a larger plant will be erected.

The New England Storage Warehouse Company, Roxbury, Mass., is putting up a new cold storage plant of large capacity.

The Rutland (Vt.) Machine and Automobile Company has been formed. O. H. Coolidge is one of the incorporators.

Contract has been awarded for the erection of an engine house for the Cherry Valley Iron Company at West Middlesex, Pa.

The Ferguson Manufacturing Company, Waterloo, Iowa, makers of drills, tools, etc., is erecting an addition to its plant.

The buildings, machinery and stock of the Hancock Leather Company, Riceville, Me., was destroyed by fire. Loss, about $35,000.

The Mark Manufacturing Company making wrought iron pipes, etc., whose plant at Evanston, Ill., was recently burned, will rebuild.

The plant of the Wheeling, (W. Va.) Metal and Mfg. Company, almost completely destroyed by fire a short time ago, is being rebuilt.

The Vandergrift (Pa.) Lock Manufacturing Company, now being incorporated with a capital of $200,000 has purchased site for a plant.

The Justinian Car Company of San Francisco, Cal., manufacturing miners' supplies and machinery will construct a plant in Los Angeles.

The Fidalgo Mill Company, Anacortes, Wash., will make extensive improvements installing new engines, boilers and up-to-date machinery.

Cadby & Son, box manufacturers, Albany, N. Y., are to erect a new factory which will be fitted up with the most approved modern machinery.

The Michigan Pipe and Iron Company capitalized at $50,000 has been incorporated at Richmond, Mich., backed by local and Detroit capital.

The Kingsley Water Tube Boiler Company, New York, is looking for an available site along the Hudson for a new plant to give employment to over 1700 men.

Plans have been prepared by the Pratt & Whitney Company, Hartford, Conn., for a five story addition to its plant to be used for machine shop and foundry purposes.

The open hearth-steel furnace under course of construction by the Illinois Steel Company at South Chicago, was destroyed by a windstorm causing a damage of $50,000.

A large addition to the ditching machine plant of the Van Bureu, Heck & Marvin Company, Findlay, Ohio, is being constructed to be used for a smith shop and foundry.

The New York Blower Company with plants at Bucyrus, Ohio, and Chicago, Ill., will combine the two and erect one large plant at Bucyrus if a suitable site can be procured.

The Pioneer Sash and Door Company is being incorporated at Thief River Falls, Minn. Capital $30,000. Incorporators, George Dabel, Robert Lang of Milton, N. D. and others.

The American Steel Dredge Works is being organized at Logansport, Ind., which will take over the foundry and machine shop of William Dowling & Co. John D. Ranch of Logansport is one of the new owners.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Special machinery to order. Inventions developed. Geo. M. Mayer, M. E., 1131 Monadnock, Bl., Chicago, Ill.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford st., Philadelphia.

Fine machinery, tools and dies built to order; experimental work a specialty. Northwestern Machine & Tool Co., 614 Union Trust Bldg., Detroit, Mich.

A working foreman familiar with gas engine work, to take charge of erecting floor. Address, with references and salary expected, Box 36, AMERICAN MACHINIST.

Wanted—To rent or purchase a small machine shop in the Eastern States suitable for manufacturing light machines. Answer giving terms Box 363, Montrose, Pa.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted.—Second hand milling machine automatic feed. Bed must extend 20 inches in front of head; must be in good condition. Mention make of machine when replying. Box 25, AMERICAN MACHINIST.

M. E., owning patents on rotary pump or blower of high efficiency and low cost, would like to meet party with capital to build and market same. Machine has been tested and is no experiment. Box 30, AMERICAN MACHINIST.

Wanted.—Reliable party to manufacture parts of a patented steering mechanism. Prefer one who can do assembling. Will send sample for estimate. Work must be done accurately and started at once. A1 references given and required. Address Box 27, AMERICAN MACHINIST.

Tool Catalogue No. 22, 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

Law of Foreign Business Corporations doing business in the state of New York, by John Henry Mann. Trading and manufacturing corporations of other states located in New York will find this book invaluable. Firms contemplating incorporation should study it. Price $3.50 delivered. Banks & Company, Law Book Publishers, Albany, N. Y.

For Sale.

For sale.—Small machine shop, in thriving N. E. village. Good opening for man with small capital. Box 26, AMERICAN MACHINIST.

For sale—Two patents—Draftsman's square and table. Patterns and drawings recently improved. 1125 Real Estate Trust, Philadelphia, Pa.

For Sale—10-ton crane, 40 ft. span, rope drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co., Burlington, Iowa.

For Sale—One No. 7 Landis Tool Grinder with automatic gear feed. Swings 20", 72" between centres, 18" wheel, 1½" face. In first-class condition. Has been very little used. The Tabor Mfg. Co., 18th & Hamilton Sts., Philadelphia, Pa.

Power plant; new, unused, emergency power plant for sale at great sacrifice. 60 H. P. Westinghouse gas engine; 60 H. P. Bullock generator; 7½ H. P. Bullock Motor 120 volts. Now installed, will sell separately. C. Kenyon Company, 718 Atlantic Ave., Brooklyn.

Business Opportunities.

$2400 interest in established manufacturing concern doing good business. Have up to date machine shop, could build automobiles. Fine chance for mechanic or experienced salesman. Part cash, balance real estate or good security. Address Box 19, AMERICAN MACHINIST.

Machine shop for sale. Here is a great opportunity for someone who wants a business of his own. This is a modern plant, located in central New York. Main buildings 100x60 ft., two stories, equipped with about 50 high-grade machine tools, including lathes, milling machines, shapers, drills, etc. Plant is adapted for automobile or any high-grade work, and is now running. This plant and business cost more than $50,000 and we can sell it for less than $12,000, if taken promptly. This price includes, patents, jigs and tools for making a very profitable specialty. To the right parties we can make very favorable terms. William A. Reade & Co., 402 Chamber of Commerce Bldg., Cleveland, Ohio.

Partner Wanted—Who has had good business experience, and possesses executive ability, and some technical knowledge, with small capital; by designer and engineer 30; 9 years' first-class experience on miscellaneous machinery, boilers, engines, conveyors, cranes, rolling mill equipment, dredging machinery, marine work, etc.; thoroughly practical and competent, technically educated, with executive ability, and small capital. Having gained valuable experience working for others, will now start for himself, in a manufacturing, machine, contracting, or engineering business on Eastern coast. Do not answer unless thoroughly competent and meaning business, giving full details. Address Box 43, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion.. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Classification indicates present address of advertiser, nothing else.

Situations Wanted.

CONNECTICUT.

Chief draughtsman; by technical graduate with 18 years' experience, 6 years in charge of office on engineering work. Box 22, AMERICAN MACHINIST.

Position assistant superintendent or chief draftsman; 15 years experience designing and manufacturing valves, hydrants and fittings. Box 3, AMERICAN MACHINIST.

NEW JERSEY.

Draftsman, 33, A1 machinist desires position; shop preferred. Box 44, AMERICAN MACHINIST.

Draughtsman, expert in mining machinery, desires position. Location no object. Box 42, AMERICAN MACHINIST.

Machinist and tool maker foreman at liberty. High grade positions. American, 30, married. I don't know everything. East of Chicago preferred. Bona fide. AMERICAN MACHINIST.

NEW YORK.

Mechanical draftsman graduate; several years' experience as draftsman and designer. Open for engagement. Box 9, AMERICAN MACHINIST.

M. E. college education, 8 years' experience hydraulic machinery, employed at present, wants position as traveling engineer or salesman. Box 29, AMERICAN MACHINIST.

General foreman, 36, successful in handling men and work to best advantage, varied experience in high grade machinery. Expert machinist. Box 23, AMERICAN MACHINIST.

Young man (28) purchasing agent, cost accountant, familiar with premium system and estimating premium allowances, design of jigs and fixtures for rapid production, desires change. Box 21, AMERICAN MACHINIST.

Wanted—Situation as production engineer. Practical experience as draftsman, machinist inspector, installation of premium systems. Have no contract with present employer. References. Address F. J. 37 AMERICAN MACHINIST.

PENNSYLVANIA.

Mechanical engineer, general mill work, wishes to change. Box 32, AMERICAN MACHINIST.

Position as master mechanic or superintendent of construction by practical man after March 1. Box 18, AMERICAN MACHINIST.

Expert designer of modern gas engines and gas producers would make a change; technical graduate, 7 years' experience, executive ability. Box 38, AMERICAN MACHINIST.

Position wanted by A1 accountant and office manager. Thorough knowledge of costs and general office work in manufacturing business. Box 24, AMERICAN MACHINIST.

Situation wanted by a first-class designing draftsman. Technical graduate, 15 years' experience in general machinery design to shop cost. A1 references. Address Box 39, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Several die makers, also tool makers for fixtures and gauge work. Ross Rifle Co., Quebec, Canada.

ILLINOIS.

Draftsman.—We have positions now open for draftsmen. Call or address Western Electric Co., Chicago, Ill.

Wanted—Draftsmen—Men accustomed to interchangeable work on small tools, jigs and fixtures. Wesern Electric Company, Chicago, Ill.

Wanted—An assistant superintendent for shops in machinery line, experienced particularly in gas engines and steam pumps; familiar with best machine tool work, piece work practice, etc. Growing position for man of ability and energy. Give references, experience, salary expected, etc. Box 20, AMERICAN MACHINIST.

MARYLAND.

Wanted—To meet our constantly increasing requirements, we invite applications from first class toolmakers, machinists, Jones & Lamson operators, Gishoit machine operators, milling machines, bench hands and pattern makers. Address Box 6P, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Operators for Gleason planers and gear cutting machines, also turret lathe men. Box 956, AMERICAN MACHINIST.

Wanted—by a well-equipped shop in country town making high grade machine tools, first class lathe man and bench man. Married man preferred. Address with references, Box 31, AMERICAN MACHINIST.

Machinists Wanted—We are increasing our force and need good all-round men for the building of special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

Wanted—A first class mechanical draftsman, one with experience on automatic machines (screw machines preferred.) Must be a man with original ideas to develop new machines. Give full experience, wages expected and state if married or single; factory near Boston. All answers will be considered strictly confidential. Box 8, AMERICAN MACHINIST.

MICHIGAN.

Wanted—General foreman to take active charge of iron and steel working plant; good opportunity for right man. Box 530, Lansing, Mich.

Gear Planer Operator—Wanted—Two operators experienced in running Gleason full automatic 36 in. gear planers; steady work; best pay. Industrial Works, Bay City, Mich.

Wanted—3 or 4 first-class, A1 automatic screw machine hands; to experienced men will guarantee steady position and highest rate of wages. Answer, with reference, to Box 85, Detroit, Mich.

Wanted—Experienced mechanical draughtsman with technical training on automobile work in one of the largest Michigan factories. Only college graduates with experience need apply. State particulars fully and wages expected. Address Box 28, AMERICAN MACHINIST.

NEW JERSEY.

Wanted—A first-class mechanical draftsman; state experience and salary wanted. Box 881, AMERICAN MACHINIST.

Wanted—Good machinists, lathe and boring mill hands on engine work. Apply Standard Motor Construction Company, 172-180 Whiton St., Jersey City.

We are increasing our works and want applications for machinists; in reply give details of experience, age and wages expected. The Edison Portland Cement Co., Stewartsville, N. J.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Wanted—Experienced foreman for machine shop. Manufacturing light machinery. Must be capable of making tools and dies, and able to take care of 25 to 30 men. Country town; steady work. Box 34, AMERICAN MACHINIST.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

NEW YORK.

Wanted—Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

Mechanics—Several for small accurate brass and steel work. State experience and wages. Box 4, AMERICAN MACHINIST.

Wanted—Draughtsmen on dies, jigs and fixtures. Steady position guaranteed to good men. Address Box 33, AMERICAN MACHINIST.

Wanted—First-class die and tool-maker, as working foreman of machine and tool department. The Pritchard-Strong Co., Rochester, N. Y.

Wanted—Several first-class tool-makers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7, Syracuse, N. Y.

Foreman wanted for manufacturing department of typewriter factory. Must have executive ability and experience in this line. Address Box 40, AMERICAN MACHINIST.

Wanted, by an engineering concern, a first-class mechanical draftsman. State age, experience, references, and salary expected. Permanent position. Box 35, AMERICAN MACHINIST.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 859, AMERICAN MACHINIST.

Wanted—Experienced draftsmen, first-class machinists, toolmakers, and gauge makers; give detailed experience, references, age and wages expected. Remington Arms Company, Ilion, N. Y.

Wanted—Several mechanical draftsmen on structural details of electrical work. Good opportunities and steady positions. State age, experience and salary. Box 7, AMERICAN MACHINIST.

Wanted—Young man to run Fox lathe; young man understanding brass finishing and buffing. Expert operator for Jones & Lamson lathe, new style. Address "Excellent", care AMERICAN MACHINIST.

Wanted—Mechanical Superintendent for factory employing 700 men. Practical experience and ability to produce results required. Location New York State. Engineering Agency, 1208 Monadnock, Chicago, Ill.

Wanted—Man of practical experience in the manufacture of small, interchangeable parts; gun work preferred; qualified to estimate on piece prices; must have good executive ability and judgment; state experience and salary expected. Box 926, AMERICAN MACHINIST.

Wanted—Man with technical training as draftsman and engineer, with experience in the design of special machine tools for economical production of interchangeable machine parts in large quantity; person with practical experience as a machinist preferred. Box 953, AMERICAN MACHINIST.

Wanted—An expert machinist and experienced salesman combined to represent a well known manufacturer in Ohio and Indiana. Must understand thoroughly cutting tools. Tool making experience desirable. State age, experience, salary expected at the start. Box 17, AMERICAN MACHINIST.

Draftsman to make working drawings from incomplete drawings, patterns, castings and finished parts; thoroughness and accuracy are essential; only applicants who desire permanent position will be considered; experience on pump or engine work desirable; location New York City; state experience and pay expected; give references. Address Box 951, AMERICAN MACHINIST.

OHIO.

Wanted—Machinist, capable of taking charge of machine shop making bakers' and chemists' mixers. A splendid opportunity for good, energetic man. Address Box 2, AMERICAN MACHINIST.

Wanted—Foreman to take charge of about 20 vise hands in Cincinnati; must be well recommended, and had charge of vise work in tool shop. Address, with references. The Cincinnati Milling Machine Co., Cincinnati, O.

Wanted—A mechanical draftsman, experienced in steam engine designing; must be a technical graduate, capable of doing the routine figuring of the drafting room; state age, experience, education and salary expected. Address The Hooven, Owens, Rentschler Co., Hamilton, O.

PENNSYLVANIA.

Wanted—High-class machinists and toolmakers. Good wages. No labor troubles. Box 41, AMERICAN MACHINIST.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMERICAN MACHINIST.

Wanted.—Fitters, machine hands and erectors on Corliss Engine work. Scottdale Foundry & Machine Co., Scottdale, Pa.

Wanted—First class floor hands with experience in assembling machine tools. Apply Stoever Foundry & Manufacturing Co., Myerstown, Pa.

Wanted—A number of A1 tool, die and instrument makers. Also wood pattern makers. Address Employment Department, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa.

Wanted—A competent engineer to act as assistant to General Manager of a large corporation manufacturing a line of cast iron specialties and to take charge of the construction and creative department of the business He must have some experience in designing and operating labor saving appliances in the iron foundry line and know how to handle men and machinery. A liberal salary will be paid to the right party. Applicant must not be over middle age, must be energetic and understand both the theory and practice of iron founding and machine shop work. Address giving age, previous experience and salary expected. "Capable" AMERICAN MACHINIST.

WISCONSIN.

A working foreman familiar with gas engine work, to take charge of erecting floor. Address, with references and salary expected, Box 36, AMERICAN MACHINIST.

To meet our constantly increasing requirements, we invite applications from first-class machinists and bench hands. Those familiar with engine work preferred. Address with references Globe Iron Works Company, Menomonie, Wisconsin.

Large concerns building excavating and railway machinery wants to correspond with first class mechanical draftsmen, with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMER. MACHINIST.

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Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.

Brackets, Lamp
Standard Welding Co., Cleve., O.

Bulldozers
Prentiss Tool & Supply Co., New York.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.

Calipers
Athol Machine Co., Athol, Mass.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.
U. S. Foundry & Sales Co., South Norwalk, Conn.
Yale & Towne Mfg. Co., Stamford, Conn.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link-Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Chucking Machines *Continued*
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

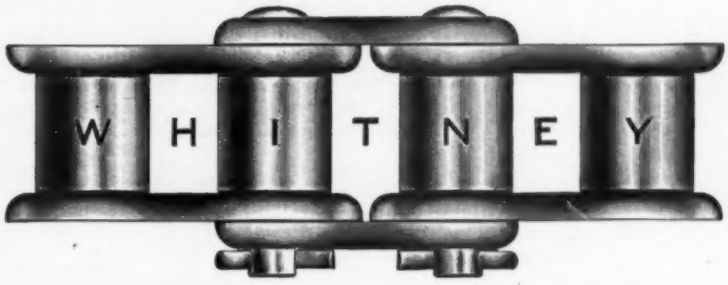
Coils
Standard Welding Co., Cleve., O.

Compounds, Boiler
Advance Mfg. Co., Kalamazoo, Mich.

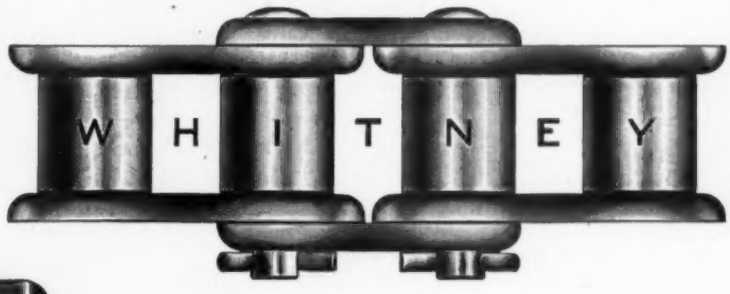
Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.

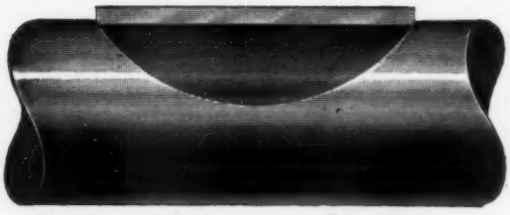
"WIZARD" Chains and Sprockets—Patented



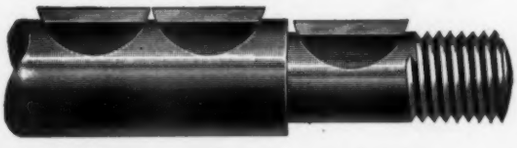
1906 Model "Whitney" Detachable Roller Chains—Patented



Block Chains



"Woodruff" Patent Keys



Three Popular Specialties

"Whitney" Chains
Hand (feed) Milling Machines
The Woodruff Patent System of Keying

THE WHITNEY MFG. COMPANY

HARTFORD, CONN., U.S.A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., Great Britain. Schuchardt & Schutte, Germany, Austria, Holland, Russia and Scandinavia. Fenwick, Freres & Co., France, Belgium, Italy, Switzerland, Spain and Portugal

Compressors, Air—*Continued*
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Mietz, August, New York.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R, Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.

Cranes—*Continued*
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Cranes, Portable
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Nicholls, Wm. S., New York.

Crank Pin Turning Machine
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Crushers
Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Elliott Chemical Works, Newton, Mass.
Winkley Co., Detroit, Conn.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
International High Speed Steel Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York.
Francis Co., Hartford, Conn.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edwin R., Chicago, Ill.

Dies, Sub-Press
Risdon, S. A., Waterbury, Conn.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.
Reliance Mach. & Tool Co., Cleveland, O.
Swaine Co., Fred J., St. Louis, Mo.

Dowel Pins
Winkley Co., Detroit, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Dwight Slate Machine Co., Hartford, Conn.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dwight Slate Machine Co., Hartford, Conn.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.

Drilling Machines, Radial *Continued*
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dwight Slate Machine Co., Hartford, Conn.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers, Boat, Gauge & Drill Wks., John M., Gloucester City, Mass.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drills, Spindle
Three Rivers Tool Co., Three Rivers, Mich.

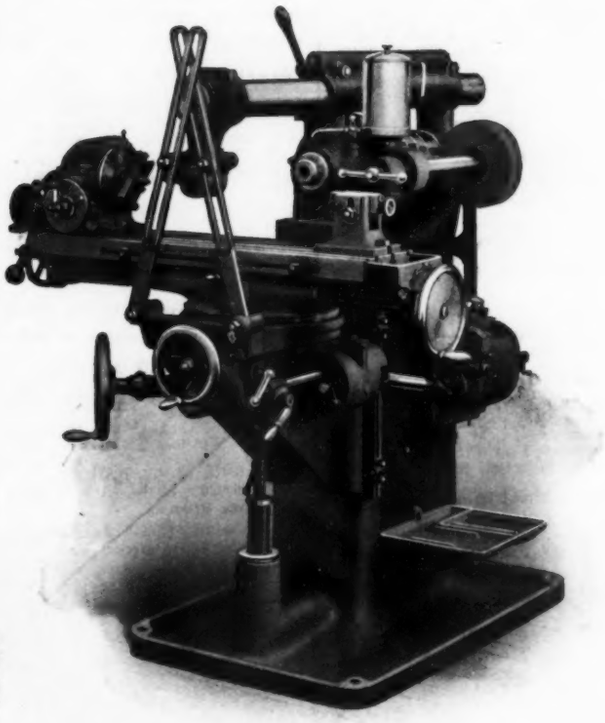
BROWN & SHARPE MFG. CO.,

Providence, R. I., U. S. A.

ADVANTAGES OF USING

B. & S. Universal Milling Machines

For Cutting Spirals, Fluting Reamers, and Milling Spiral Cutters.



The range of the swivel table is sufficient to allow the cutting of any lead generally used.

The saddle that carries the table can be rigidly clamped to it by 3 T bolts that slide in a circular slot of large diameter.

The bearings of the table in the saddle are amply proportioned to insure rigidity.

The swivel is graduated to half degrees, for convenience in setting the table to the desired angle.

The table has quick return operated from the right-hand end by an internal gear and pinion, of ample leverage to secure ease of manipulation.

The feed screw is not splined, thus the thread is unbroken and the original accuracy of the screw maintained.

The spiral head is rigidly constructed. The worm wheel is of comparatively large diameter, and, as it is not disengaged from the worm, the extreme accuracy is not impaired.

The Universal Milling Machine Pamphlets, showing all the machines and giving full specifications, sent upon application.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors
Allington & Curtis Mfg. Co., Saginaw, Mich.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Dynamotors
Sprague Elec. Co., New York.

Electrical Supplies
Clark, Jr. & Co., Jas. Louisville, Ky.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Clark, Jr. & Co., Jas. Louisville, Ky.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Roth Bros. Co., Chicago, Ill.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Employment Agency
Engineering Agency, The, Chicago, Ill.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Francis & Co., Hartford, Conn.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.
Reeves Pulley Co., Columbus, O.

Engines, Gas and Gasoline
Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.

Engines, Gas and Gasoline *Continued*
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buckeye Engine Co., Salem, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Engravings
Springfield Photo-Engraving Co., New York.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., W. H., Wilkesbarre, Pa.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines
Detrick & Harvey Mach. Co., Baltimore, Md.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Henry & Wright Mfg. Co., Hartford, Conn.

Fillets, Leather
Cleveland Fillet Co., Cleveland, O.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Boker & Co., Hermann, N. Y.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
McInnes Steel Co., Corry, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
Manufacturing Equip. & Engineering Co., E. Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Machine Co., Hartford, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.

Gears, Cut—*Continued*
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Eickemeyer Mfg. Co., Yonkers, N. Y.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Morse, Williams & Co., Phila., Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
VanDorn & Dutton, Cleveland, O.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincinnati, O.

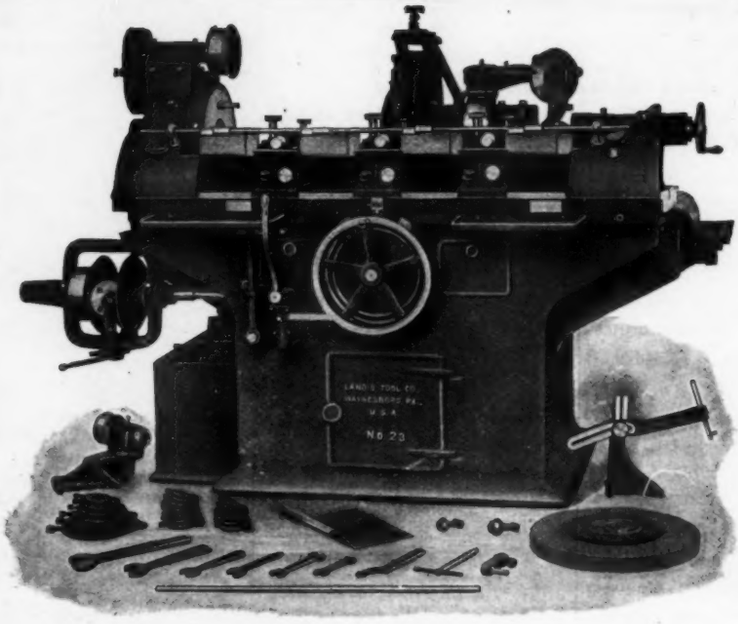
Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Rivett-Dock Co., Boston, Mass.



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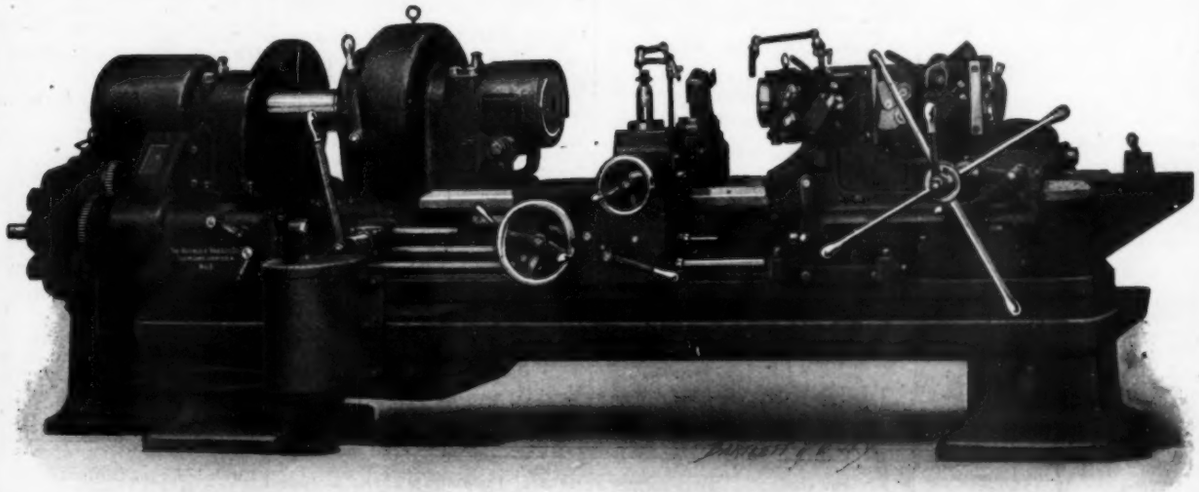

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Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York
Rivett-Dock Co., Boston, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Cylindrical

Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk

Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill

Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal

Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Wells & Sons Co., F. E., Greenfield, Mass.

Grinders, Piston Ring

Heald Mach. Co., Worcester, Mass.

Grinders, Portable

Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Dwight Slate Machine Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

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Barnes Co., W. F. & John, Rockford, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Dayton Mach. & Tool Works, Dayton, O.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Stow Mfg. Co., Binghamton, N. Y.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wells & Sons Co, F. E., Greenfield, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I
Hampden Cor. Wheel Co., Bright wood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames

Niles-Bement-Pond Co., New York
Athol Machine Co., Athol, Mass.

Gun Barrel Machinery

Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic

Cleveland Pneu. Tool Co., Cleveland, O.
International Steam Pump Co., New York.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Hammers, Power

Fairbanks Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam

Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineerin Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
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Handles, Machine Tool

Whitman & Barnes Mfg. Co. Chicago, Ill.

Handles, Screw Plate

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Hangers, Shafting

Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
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Link-Belt Engineering Co., Philadelphia, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

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Chicago Flexible Shaft Co., Chicago, Ill.

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Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
United Engineering & Fdry. Co., Pittsburg, Pa.

Hoists, Electric

C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand

Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

Cleveland Pneu. Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Nicholls, Wm. S., New York.
Northern Engineering Works, Detroit, Mich.

Hose, Steel

Sprague Elec. Co., New York.

Igniters, Gas Engine

Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed

Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral

Warner Instrument Co., Beloit, Wis.

Indicators, Test

Reisner Mfg. Co., W. H., Hagerstown, Md.

Industrial Railways

Hunt Co., C. W., West New Brighton, N. Y.

Injectors

Desmond-Stephan Mfg Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests

Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools

See Schools, Correspondence

Instruments, Electric

General Electric Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

Insurance, Boiler

Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler

Felton, Sibley & Co., Phila., Pa.
Clark Cast Steel Cement Co., Shelton, Conn.

Jacks, Hydraulic

Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer

Armstrong Bros. Tool Co., Chicago, Ill.

Kettles, Soda

Mfg. Equip. & Engrg. Co., E. Boston, Mass.

Key Seaters

Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Lapointe Machine Tool Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Shear

Phillips & Sons Co., F. R., Philadelphia, Pa.

Knurls

Hammacher, Schlemmer & Co., New York.

Lamps, Arc

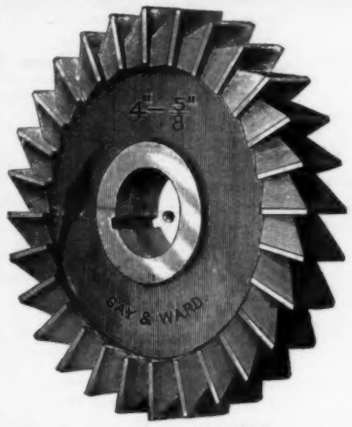
General Electric Co., N. Y. City.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent

General Electric Co., New York.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments

American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.



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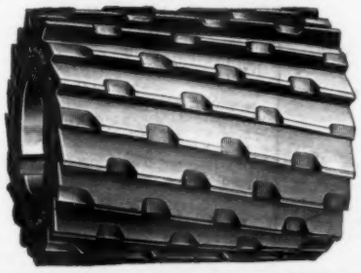

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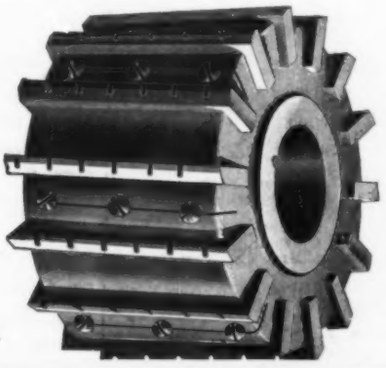

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Tindel-Morris Co., Eddystone, Pa.

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American Tool & Machine Co., Boston, Mass.
American Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Mach. Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Shepard Lathe Co., Cincinnati, Ohio.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mch. Tool Co., Springfield, O.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Wells & Sons Co., F. E., Greenfield, Mass.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Waltham Machine Works, Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Lathes, Brass
Dreses Mach. Tool Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Windsor Mach. Co., Windsor, Vt.

Lathes, Extension
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.

Lathes, Foot Power
Barnes Co., W. F. & Jno., Rockford, Ill.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathes, Speed
Blount Co., J. G., Everett, Mass.

Lathes, Wood
Prentiss Tool & Supply Co., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., New York.

Levels
Starrett Co., L. S., Athol, Mass.

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Merritt & Co., Philadelphia, Pa.

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Yale & Towne Mfg. Co., New York.

Locomotives, Electric
General Electric Co., New York.

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Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
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Lunkenheimer Co., Cincinnati, O.

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Chandler & Farquhar, Boston, Mass.
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Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Machinists' Small Tools
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Bemis & Call Hardware & Tool Co., Springfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
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Hammacher, Schlemmer & Co., New York.
Le Count, Wm. G., So. Norwalk, Conn.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
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Nicholson & Co., W. H., Wilkesbarre, Pa.

Mandrels, Solid
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Morse Twist Drill & Mach. Co., New Bedford. Mass.
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Schellenbach & Radcliffe, Cin., O.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

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Dwight Slate Machine Co., Hartford, Conn.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
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American Watch Tool Co., Waltham, Mass.
Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

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Whitney Mfg. Co., Hartford, Ct.
Brown & Sharpe Mfg. Co., Providence, R. I.

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Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
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Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Kempsmith Mfg. Co., Milwaukee, Wis.
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Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

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Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
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Garvin Mach. Co., New York.
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Kempsmith Mfg. Co., Milwaukee, Wis.
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Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
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Owen Mach. Tool Co., Springfield, Ohio.
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Prentiss Tool & Supply Co, New York.
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Underwood & Co., H. B., Philadelphia, Pa.

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Aurora Tool Works, Aurora, Ind.
American Tool Wks. Co., Cin., O.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co, Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

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Adams Co., Dubuque, Iowa.
Beaman & Smith Co. Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
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Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

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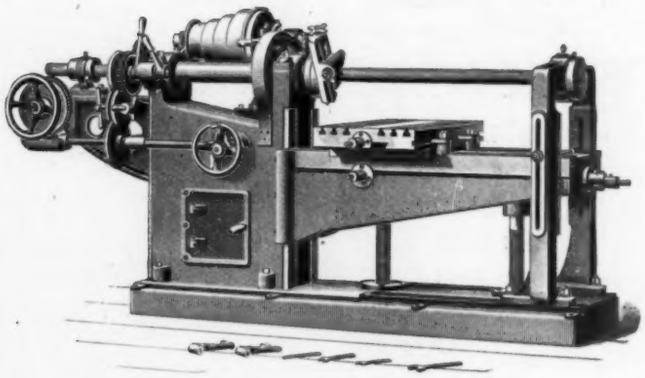

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Standard Tool Co., Cleveland, O

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Gray Co., G. A., Cincinnati, O.

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Betts Mach. Co., Wilmington, Del
Bilgram, Hugo, Philadelphia, Pa.
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Detrick & Harvey Mch. Co., Baltimore, Md.
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Garvin Mach. Co., New York.

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Watson-Stillman Co., New York.

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Miner & Peck Mfg. Co., New Haven, Conn.
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Presses, Hand
Bliss Co., E. W., Brooklyn, N. Y.

Presses, Hydraulic
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Automatic Mach. Co., Bridgeport, Conn.
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Prentiss Tool & Supply Co., New York.
Springfied Mach. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

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Garvin Mach. Co., New York.
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Prentiss Tool & Supply Co., New York.

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Henley Pub. Co., Norman W., New York.

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Modern Machinery Publishing Co., Chicago, Ill

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Dallett Co., Thos. H., Phila., Pa.
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Niles-Bement-Pond Co., New York.
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Chambersburg Engineering Co., Chambersburg, Pa.

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United Engineering & Fdry. Co., Pittsburg, Pa.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

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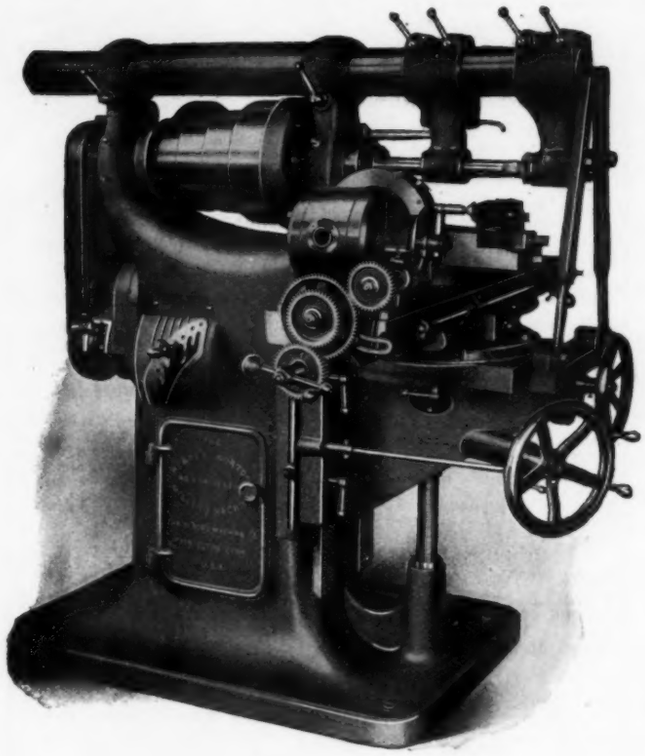

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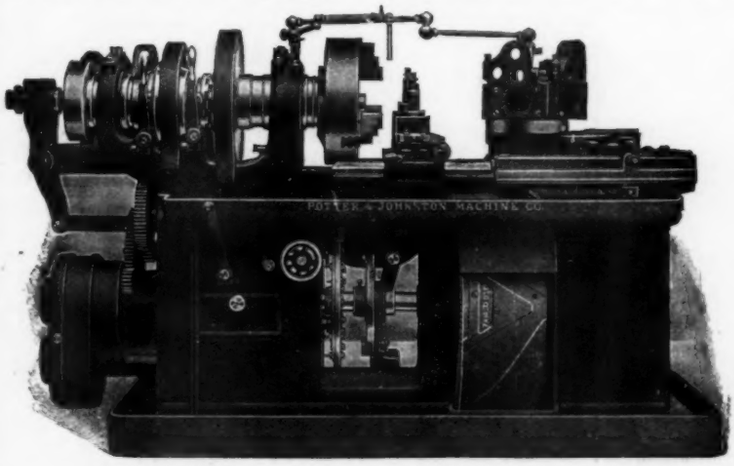

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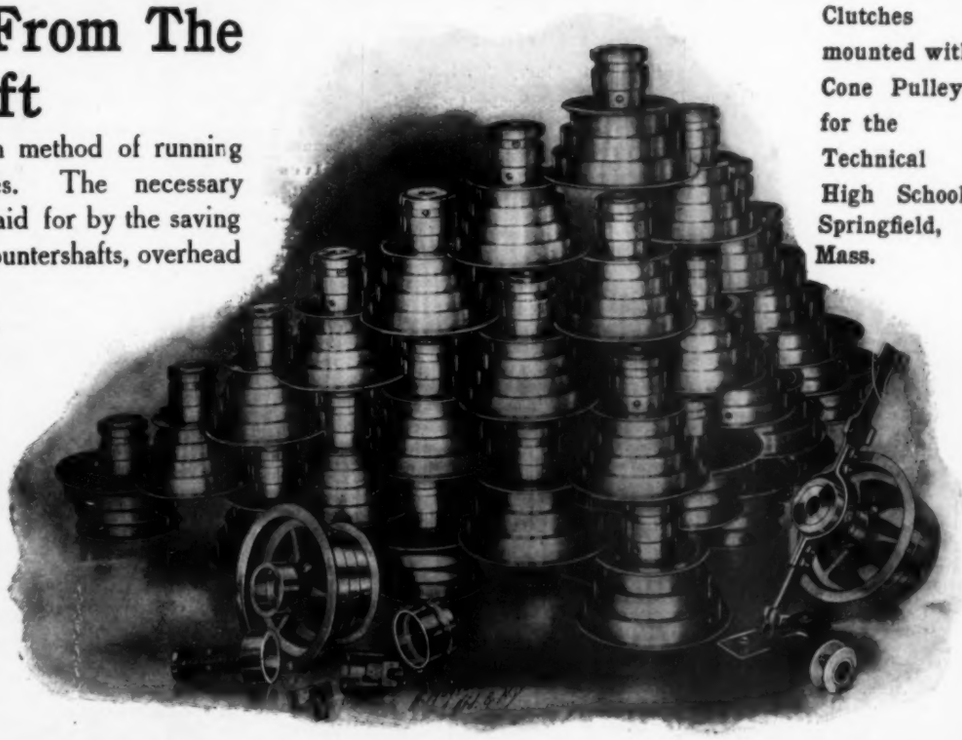

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A Large Rotary Pump Plant.

For some time past a development in the use of rotary irrigating pumps has been going on in the Southern rice fields, which, because of its remoteness from the centers of engineering activity, has attracted less attention among engineers than it deserves. Through the courtesy of the Connersville Blower Company, of Connersville, Ind., we are able to present some illustrations of this line of work, the magnitude of which will, we think, take most of our readers by surprise. While the plant shown is the largest so far produced by its builders, it is by no means a novelty with them, as they have built for similar use in Louisiana and Texas plants having an aggregate capacity of 1,100,000 gallons per minute.

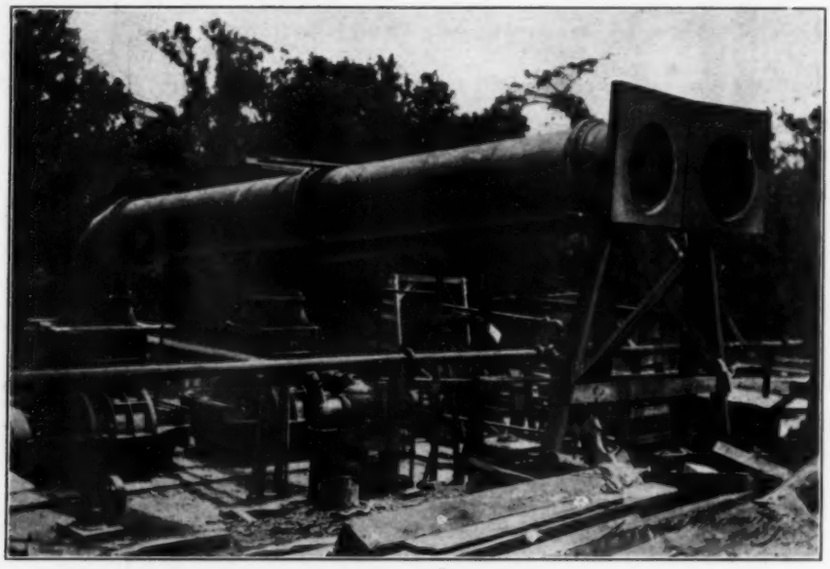

FIG. 1. THE PINE ISLAND PLANT IN PROCESS OF ERECTION.

The pumps are of the cycloidal impeller type, which is well known in connection with the company's blowers for foundry and furnace use, and represent a new application of that type of machine. Their success is due to the recognition of principles which have heretofore escaped attention. First of these is the necessity for the absence of enclosed compression pockets between the impellers. Such pockets are admissible when pumping air or gases under light pressure, but are obviously inadmissible when dealing with incompressible liquids. Second is the necessity for air chambers. Because the discharge of pumps of this class is continuous, it seems to have been assumed to be uniform, or at least that air chambers were not needed. The fact is that during the rotation of the impellers there is a regular alternation of acceleration and retardation in the movement of the water, which, at anything above very moderate speeds, gives rise to serious water hammer unless ample air chambers are used. Third is the limitation of the machine to moderate lifts.

The irrigating plant under description was built for the Neches Canal Company, of Beaumont, Texas, and consists of two pumping plants, each of a capacity of 140,000 gallons per minute. Two pumping plants were installed, in order to divide the lift. To have made the entire lift at one plant would have involved raising the canal a distance of 10 feet for a length of two miles, and it was found to be cheaper to divide the lift than to build this elevated canal.

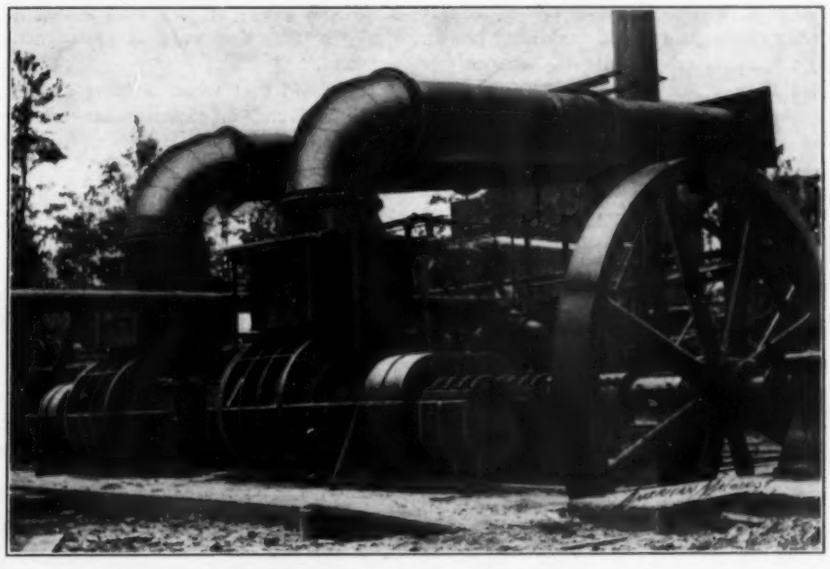

FIG. 2. THE PINE ISLAND PLANT IN PROCESS OF ERECTION.

The first plant is located on the bank of Pine Island Bayou, and has a lift of 35 feet, while the second has a lift of only 10 feet. The first plant consists of four two-lobe cycloidal pumps of 39 inches pitch diameter, the impellers being of 58½ inches outside diameter, and 544 inches length, with a displacement of 628 gallons per revolution. The solidity of the construction is illustrated by the fact that the bearings are of 11 inches diameter by 30 inches length. Each pump is coupled direct to an 18x36x48-inch compound condensing Corliss engine. Two views of the plant in process of erection are given in Figs. 1 and 2, the magnitude of the plant being indicated by the fact that the overhead discharge pipes are 48 inches in diameter. A cross section of the plant, showing the location of the engines, the suction and discharge pipes and the connection of the latter with the flume which leads the water to the canal, is given in Fig. 3.

The second plant consists of two units, each of double the volumetric capacity of the units of the first. The diameter of the impellers is the same, but the length is 104 inches, while the engines have cylinders of 14x28x42 inches. A view of this plant under erection is shown in Fig. 4, the workmen standing about it giving a clear idea of its general dimensions. There is, with this plant, no connecting piping, the suction and discharge being vertically below and above the pumps, as shown in the section Fig. 5. The steel flume into which each pump discharges is 104 inches wide by 5 feet deep.

Fig. 6 shows plan, elevations and section of the pumps from which the locations of the air chambers will be clear. The effort in designing these air chambers has been to get them as close as possible to the impellers, and to give a large area of entrance, in order that the vibrating columns of water may be as short as possible, and the velocity of the water into and out of the chambers be as low as possible.

A constructive feature of interest is the use of keys of babbitt metal in the couplings between engines and pumps. These keys are made strong enough to carry the load, but will shear in case a

piece of wood or other obstacle gets into the pump.

No fuel test of the plant has been made, but indicator cards from the first plant when running at 55 revolutions per minute show 82.7 per cent. of the indicated horse-power to be delivered in foot-pounds of water. The second plant when similarly tested gave a figure of about 80 per cent., and other plants have given figures as high as 84 per cent.

During dry summer weather the plants are required to operate continuously, and continuous day and night runs of thirty to forty days' duration have been made. As may well be surmised, such plants of pumping machinery have proven to be of commanding importance in the rice field country, and their development to the high degree of efficiency and reliability indicated, we think, reflects great credit upon the engineer and original organizer of the company, John T. Wilkin.

The Fanche Blow Pipe.

BY W. H. BOOTH.

The Fanché Acetylene-Oxygen blow pipe is a French device which has recently been introduced in Great Britain and it is an apparatus of great power. It is a blow pipe supplied with acetylene gas from any convenient source. Into the side of the nozzle is entered another pipe through which oxygen is introduced from a pressure vessel of that gas. The result is a blow pipe flame of extraordinary intensity and calorific power. The temperature is said to be 3600°C= 6512°F.

The demonstrations of the capacity for usefulness of the Fanché blow pipe consisted chiefly of welding processes, tubes being welded circumferentially and longitudinally, angle irons being welded, tubes joined together to form T pieces, and as a demonstration of temperature fire-brick was melted and a piece of calcium carbide was actually run into liquid. In joining two pieces of tube the pieces are laid together so that there is a V gap between them which enables the pointed flame to play first at the bottom of the breadth to be welded. This being heated up, the metal from above and from a rod of pure iron is run into the gap and the weld is thus carried forward.

It is said that when welding steel the pure iron rod is partially converted to steel by absorption of carbon from the flame which is not fully supplied with oxygen. This slight shortness of oxygen produces a reducing flame, thereby preventing oxidation of the metal. The weld is left slightly full so that it can be filed or ground smooth. The weld is very perfect and a welded tube will bear beating flat on an anvil.

The welding of steel by this process is practically identical with the ordinary blow-pipe soldering of lead with a stick of solder, the efficiency of the furnace being due to the great heat which can be brought to bear at one spot. Little is lost by the flame extending over contiguous surfaces. In welding electrically it is quite usual to press the parts together and thereby shorten their length, and provision must be made for this

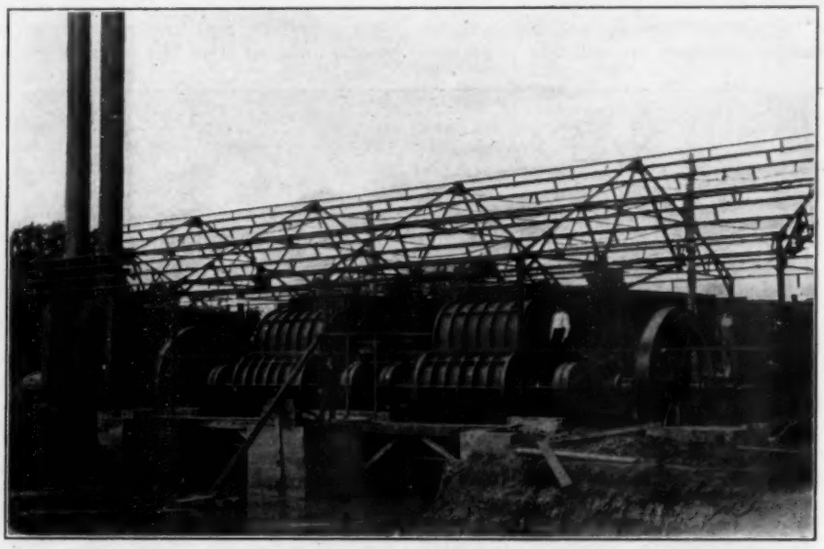

FIG. 4. THE SECOND LIFT PLANT IN PROCESS OF ERECTION.

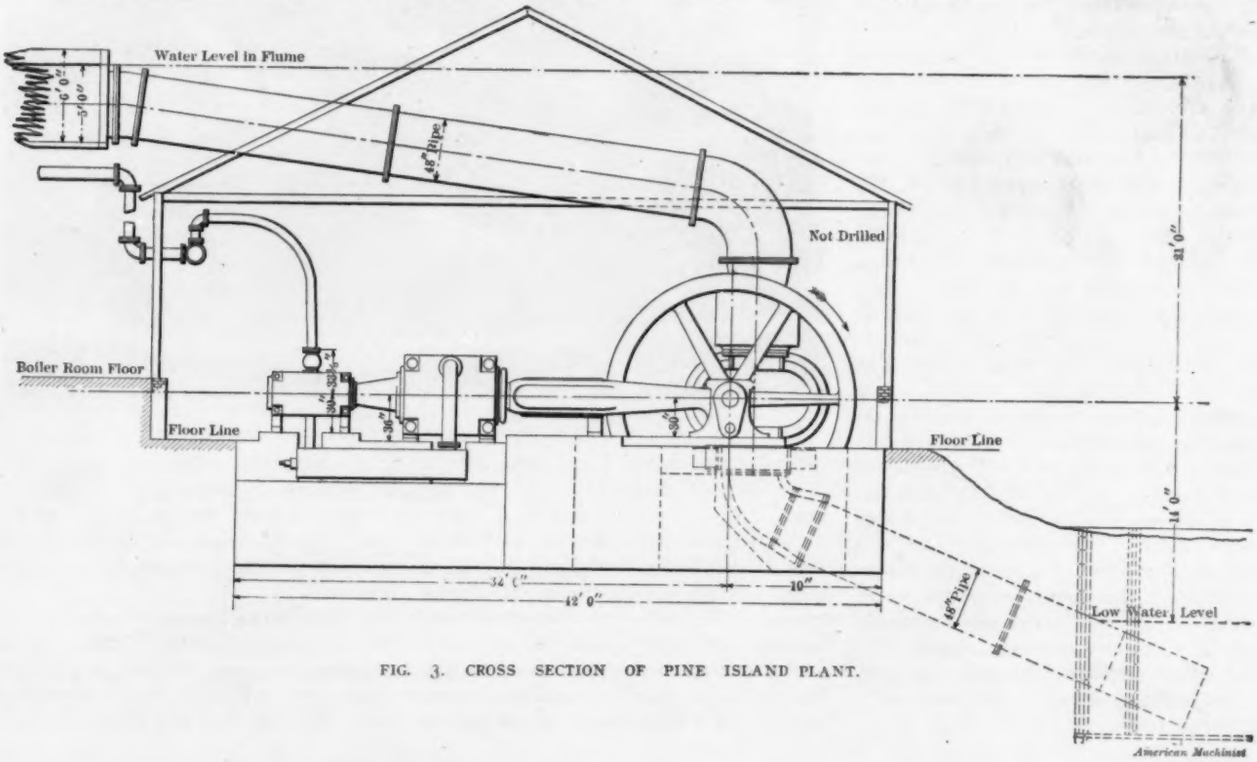

FIG. 3. CROSS SECTION OF PINE ISLAND PLANT.

action when joining up important pieces such as a frame bar in a locomotive. With the blow-pipe weld the frame ends are held to correct place and the weld is begun from the lower edge, and the gap where the material has been cut out to form the V gap is gradually filled up with fresh metal.

I have described the blow pipe as employed on steel welding but this does not of course complete the list of its uses. It can be used to mend any metal where the operator can get to apply it. It might be difficult to mend a crack from below, but given a position in which it can be worked, I should say it would mend a broken cylinder or a broken shaft, though how many bottles of oxygen would be required to mend a large screw shaft is not perhaps yet known.

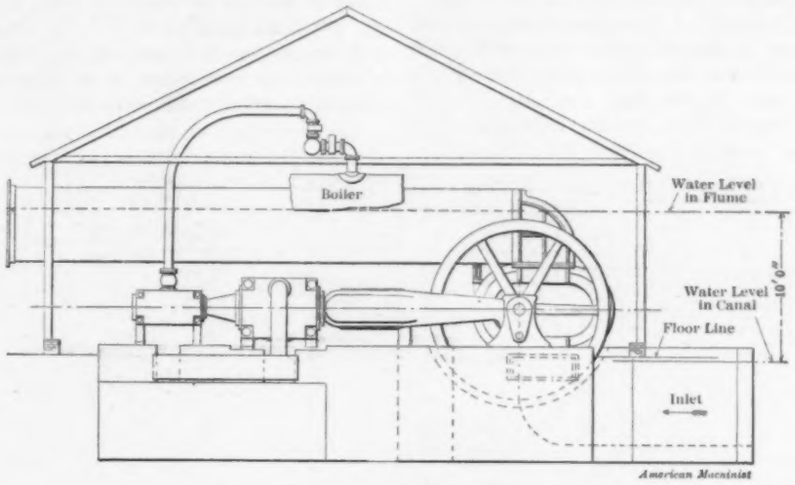

FIG. 5. SECTION OF SECOND LIFT PLANT.

Standardized Drillings of Gray Iron.

The Secretary of the American Foundrymen's Association informs us that the Bureau of Standards of the Department of Commerce and Labor, Washington, has taken over the work of the standardizing bureau of the association. In this connection Mr. Moldenke says:

The American Foundrymen's Association has been highly honored by this recognition of its work, and the undoubted broadening out of the preparation of standard drillings now to be expected, will greatly enhance the value of standards for check determinations in the iron and steel industry.

It is but fitting to recall the fact that to our President, Mr. Thomas D. West, belongs the credit of first calling attention to the advantages such a series of gray-iron borings, duly standardized by the ablest chemists of the country, would be to iron laboratories. To him for the successful building up of the enterprise, as well as to Prof. Smith, of the Case School of Applied Science, for the details of manipulation, chemists all over the world are grateful, for the standards of the association are accepted everywhere as arbiters in case of dispute.

Director Stratton, of the Government Bureau of Standards, informs us that all orders for the drillings should be sent to the "Bureau of Standards," Washington, D. C. To avoid delay the remittance at the rate of $2.00 per sample of 150 grams, or three samples of 150 grams each for $5.00, should accompany the order, and this may be in form of a check or post-office order made payable to the Bureau of Standards.

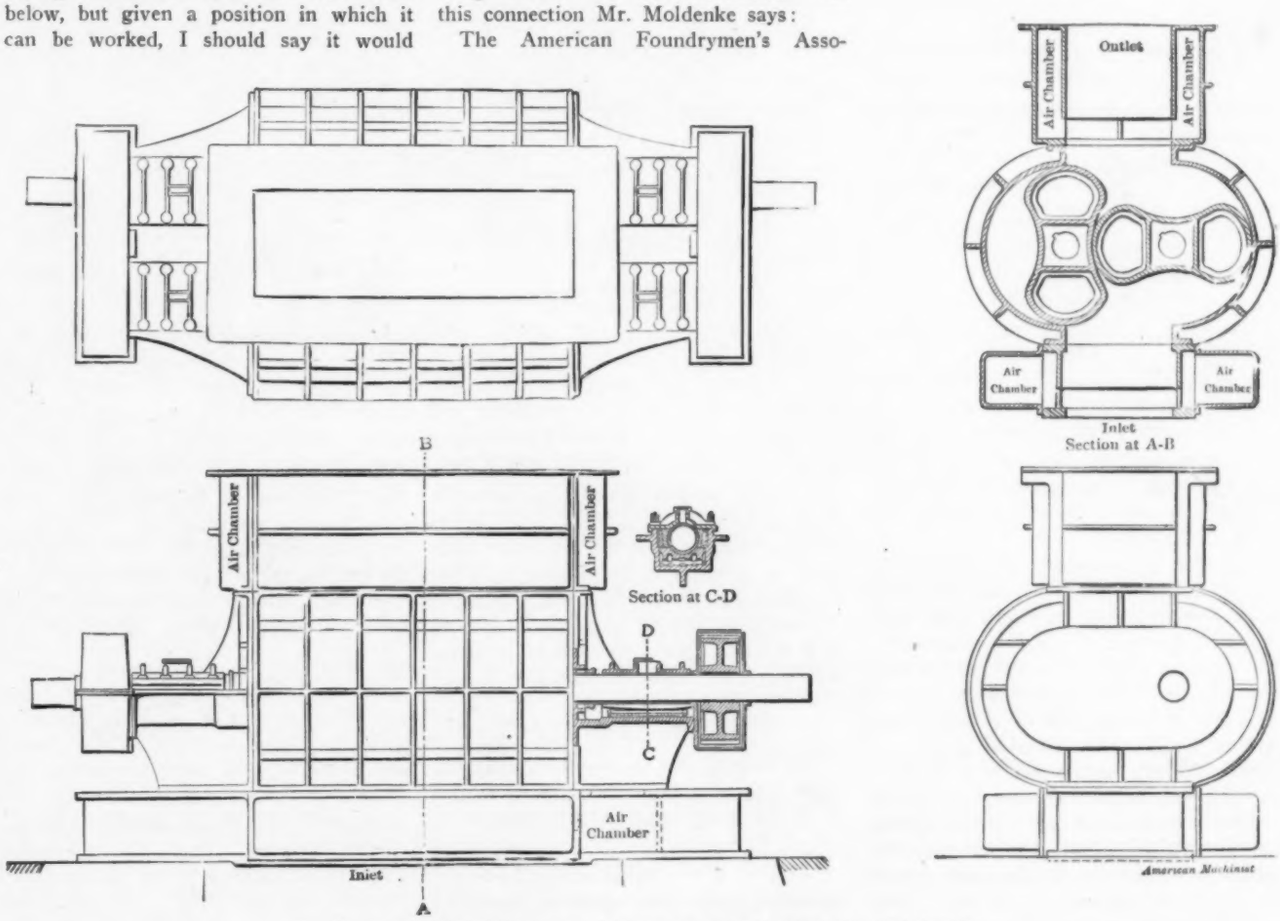

FIG. 6. PLAN ELEVATIONS AND SECTION OF PUMPS AND AIR CHAMBERS.

Designing Spiral Gears.

BY F. J. BOSTOCK.

So much has been written about spiral gears lately that there may not seem to be much possibility of introducing anything further that will be of use and general interest; but, knowing that most beginners, and often draftsmen, I fear, have hazy notions of such gears, experiencing, as they do, considerable trouble in designing them, I hope to elucidate the matter somewhat and to enable them to be designed without formulas and with as little knowledge of trigonometrical ratios as possible.

To avoid many of the calculations involved in the usual "cut and try" methods, the one illustrated is graphical, the calculations being used as a check and to obtain the angles with greater exactness.

Fig. 1 shows the circumference of a gear developed in a plane and in which $A\,O$ is the circumference, which equals $\pi \times$ diameter.

$B\,O$ is the normal helix, which equals normal pitch $\times$ number of teeth.

$A\,E\,F$ is the spiral angle.

$O\,L$ is the lead.

Triangles $A\,B\,O$, $A\,E\,o$, $a\,b\,o$ are similar and therefore

$$\text{Angle } B\,O\,A = A\,E\,F = b\,o\,a = \text{spiral angle} = \alpha$$

$$\text{also } \frac{B\,O}{A\,O} = \frac{\text{normal helix}}{\text{circumference}} = \frac{\text{normal pitch} \times \text{number of teeth}}{\text{circumference}}$$

Dividing numerator and denominator by π we have:

$$\frac{B\,O}{A\,O} = \frac{\dfrac{\text{normal pitch}}{\pi} \times \text{number of teeth}}{\dfrac{\text{circumference}}{\pi}}$$

$$\frac{\text{number of teeth}}{\dfrac{\text{diametral pitch}}{\text{diameter}}}$$

$$\therefore \frac{B\,O}{A\,O} = \cos \alpha = \frac{\text{number of pitch}}{\text{diametral pitch}} \times \frac{1}{\text{diameter}}$$

That is to say,

If $A\,O$ represents the diameter of the gear,

$B\,O$ represents the No. of teeth ÷ dia. pitch,

$O\,L \times \pi$ represents the lead of sipral.

We must not confuse the diametral pitch of a spiral with that of a spur gear in the sense of diameter ÷ number of teeth, but must regard it as the normal pitch divided into π; that is, the stock cutter that would be used for cutting. If we have such diagrams for a pair of spiral gears, the lengths of their normal helices, $O\,B$, would be inversely proportional to their speeds. As the normal helix is composed directly of the number of teeth and the diametral pitch, we must make this the starting point in our design, because we require:

(1) A whole number of teeth.

(2) A diametral pitch suiting a stock cutter.

(3) Number of teeth inversely proportional to speeds.

On the same idea we have Fig. 2, which is a diagram showing at a glance, without calculation, the relation between the diameter, angle of spiral, number of teeth, and diametral pitch of any gear within its range.

Example.—A spiral gear is wanted with about 40 degrees spiral angle on a diameter of 4 inches. What pitch and number of teeth can we have?

From 4 inches on the vertical scale of Fig. 2, which represents the diameter, follow the arc around until it cuts the radial line representing 40 degrees, from which point projecting on to the horizontal scale gives us 3, which is the number of teeth ÷ diametral pitch. We may therefore have 18 teeth of 6 diametral pitch, 24 teeth of 8 diametral pitch, 30 teeth of 10 diametral pitch, etc., since in each case

$$\frac{\text{number of teeth}}{\text{diametral pitch}} = 3$$

The diagram can be used inversely thus: What size gear would have 25 teeth of 8 pitch, the spiral angle being 50 degrees?

We have $\frac{25}{8} = 3.125$, which projected from the lower scale, cuts the 50-degree radial line on an arc of approximately 4.85 inches, thus giving the diameter.

Further use will be made of the diagram in the following example:

Design a pair of equal spiral gears having a total angle of 90 degrees and a diameter of about 2 inches.

From Fig. 2 we see that the 2-inch arc cuts the 45-degree radial line at 1.4 on the lower scale—that is to say,

$$\frac{\text{number of teeth}}{\text{diametral pitch}} = 1.4$$

We may therefore have 17 teeth of 12 diametral pitch, 14 teeth of 10 diametral pitch, 11 teeth of 8 diametral pitch, etc.

The more that we vary from 1.4 in our division, the greater will be the alteration from the intended diameter. The pitch used is often determined by the pressure per tooth that has to be transmitted, and the smoothness of running required.

We will calculate the diameter for 14 teeth, 10 diametral pitch. As before

$$\frac{B\,O}{A\,O} = \cos.\ \alpha$$

$$= \frac{1.4}{\text{diameter}} = \cos\ 45°$$

and we have

$$\text{diameter} = \frac{1.4}{\cos.\ 45°} = 1.98$$

Also

$$\frac{A\,O}{L\,O} = \tan.\ \pi$$

that is

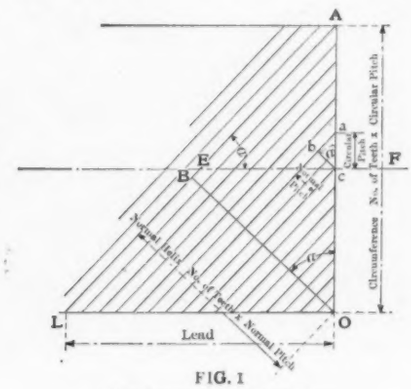

FIG. 1
Developement of a Spiral Gear

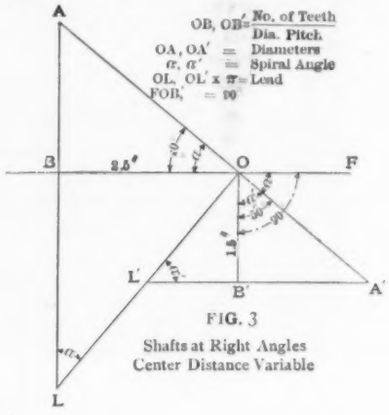

FIG. 3
Shafts at Right Angles
Center Distance Variable

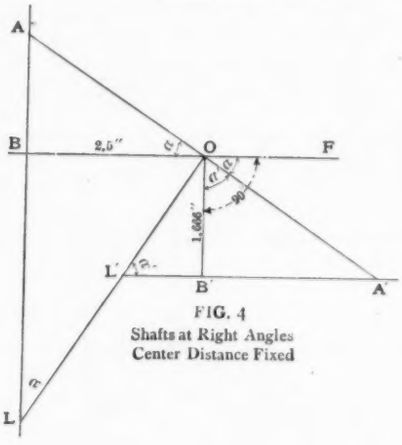

FIG. 4
Shafts at Right Angles
Center Distance Fixed

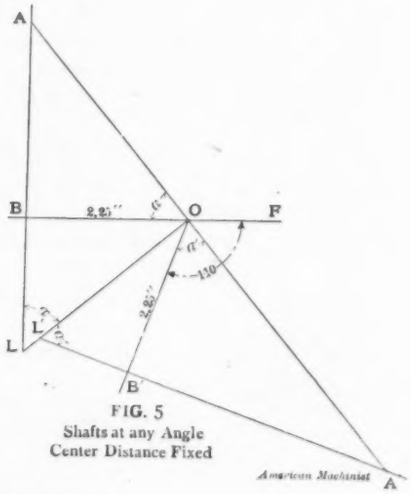

FIG. 5
Shafts at any Angle
Center Distance Fixed

$$\frac{\text{diameter} \times \pi}{\text{lead}} = \tan.\ 45°$$

$$\therefore \text{lead} = \frac{\pi D}{\tan.\ \alpha} = \pi \times 1.98 = 6.23''$$

Example.—Design a pair of spiral gears having a speed ratio of 5 : 3, axes at 90 degrees, and diameters of about 3.25 and 2.25 inches, the center distance, however, not fixed.

As these gears are to run at different speeds their normal helices must be inversely proportional, in length, as that ratio. That is, we require two numbers on the horizontal scale of Fig. 2, bearing

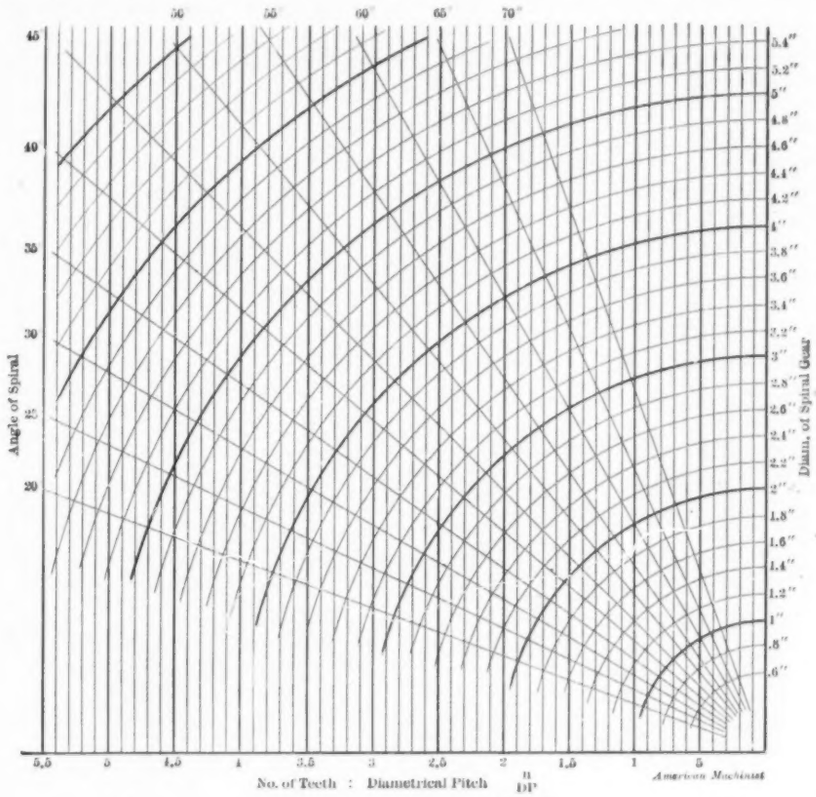

FIG. 2. SPIRAL GEAR DIAGRAM.

that ratio to each other, and whose vertical lines cut the radial ones respectively, such (1) that the sum of the angles represented equals the angle of their axes; (2) that the arcs drawn from these points are 3.25 and 2.25 inches, bearing in mind that it is best to keep the angles within 30 and 60 degrees.

Proceed therefore to follow with the eye the arcs for 3.25 and 2.25 inches from the vertical scale until they cut radial lines, such that the total angle is 90 degrees, and when projected on to the lower scale the numbers so obtained have the ratio of 5 : 3. When they are projected on to the 45-degree line we have on the lower scale 2.3 and 1.6, which are not in the ratio of 5 : 3, but a little adjustment will give the requisite numbers, namely 3.25 at 40 degrees, and 2.25 at 50 degrees, which give 90 degrees as sum of the angles and 2.5 and 1.5 on the lower scale, which bear the required ratio. Now as 2.5 and 1.5 represent the number of teeth ÷ diametrical pitch we can use any of the following: 25 and 15 teeth of 10 diametrical pitch, 30 and 18 teeth of 12 diametrical pitch, 35 and 21 teeth of 14 diametrical pitch, etc.

Thus we have a range of number of teeth and diametral pitches to select from, and the ones adopted must be in accordance with the requirements of the drive.

The diameters may be calculated as before or worked graphically as in Fig. 3, in which from a point O we draw two lines, FOB and OB', such that the angle FOB' is the axes angle, in this case 90 degrees. We make OB, OB' equal to the numbers given on the horizontal scale of Fig. 2, namely 2.5 and 1.5 inches, from B and B' we draw AB, $A'B'$ at right angles and produce them to L, L'. Through O we draw AOA', such that the angle AOB is the spiral angle of the gear whose normal line is represented by OB, that is 40 degrees. On completion we have:

AO, $A'O'$ representing the diameters.

AB, OB' representing the number of teeth ÷ diametral pitch.

α α' representing the spiral angles,

$OL \times \pi$, $OL' \times \pi$ representing the leads, and from the diagram we measure

Diameters = 3.263 and 2.33 inches, respectively.

No. of teeth ÷ dia. pitch as before = 2.5 and 1.5, respectively.

Spiral angles = as before, 40 and 50 degrees, respectively.

Leads of spirals, 12.22 and 6.151 degrees, respectively.

In order to calculate them if desired, we would say:

$$\text{Diameter} = \frac{\text{number of teeth}}{\text{diametral pitch}} \div \cos.\ \alpha$$

$$\text{Lead} = \pi \times \frac{\text{number of teeth}}{\text{diametral pitch}} \div \sin.\ \alpha$$

Example.—Design a pair of spiral gears with fixed centers of 3 inches distance; speed ratio to be 3:2, angles of axes 90 degrees.

From our diagram, Fig. 2, we require two points on the lower scale, bearing the ratio of 3:2, which, when projected to the radial lines, cut them such that the sum of their respective radii gives us twice the center distance, while the sum of the angles is 90 degrees.

With gears of about equal size—that is, 3 inches each—we have, when cutting the 35- and 55-degree lines, respectively, 2.5 and 1.666 on the lower scale, which are as 3:2. With gears having 45-degree spiral angles we should require 3.6 and 2.4 inches as respective diameters, and 2.55 and 1.7 (on the lower scale) as their

$$\frac{\text{number of teeth}}{\text{diametral pitch}}$$

Others may be obtained in like manner, but the ones adopted will be those which will suit the requirements best.

Assuming the former are used, namely, 2.5 and 1.666, on horizontal scale, with 2.5 and 1.666 we may have 30 and 20 teeth of 12 diametral pitch; with 2.4 and 1.6 we may have 24 and 16 teeth of 10 diametral pitch; with 2.6125 and 1.75 we may have 21 and 14 teeth of 8 diametral pitch.

Also assuming that 30 and 20 teeth of 12 diametral pitch are specially suitable for our drive, we will design for them: Construct Fig. 4 as before, for the lines OB, OB', AB, $A'B'$, making OB, OB' equal, to some scale, to

$$\frac{\text{number of teeth}}{\text{diametral pitch}}$$

namely, 2.5 and 1.666 inches. Our line AOA' must be equal to twice the center distance—that is, 6 inches—because it is the sum of the diameters, also as a straight line passing through the point O.

This is best found by sliding 6 inches of a rule along the lines AB, $A'B'$ until the point O is touched; then draw line AOA', giving AO, $A'O$ as respective diameters. Draw $OL'L$ at right angles as before, giving, when multiplied by π, their leads, giving:

Diameters = AO, AO, = 3.011" and 2.989.

Leads = $\pi \times OL$, $\pi \times OL'$

$= \pi \times 4.483$, $\pi \times 2.007$

$= 14.8"$ and $6.306"$

$$\text{Cos. } \alpha, \text{ cos. } \alpha' = \frac{2.5}{3.011}\ \frac{1.666}{2.989} = .8302,\ .5575$$

Spiral angles α, α' = 33° 52' 30" and 56° 6' 30".

Example.—Design a pair of spiral gears. Center distance fixed at 4 inches, angle of shafts 110 degrees, speeds to be equal.

In this example precisely the same meth-

od of procedure is adopted, emphasis being laid on the fact that the angle $F\,O\,B'$ must be made equal to the angle of the shafts.

Turning to Fig. 2 again, we require a number on the lower scale whose vertical lines will cut two radial arcs, whose sum of angles equals 110 degrees, on two points such that the diameters represented on the vertical scale will, when added together, equal 8 inches (twice the center distance).

It will be seen that 2.25 is such a point, because it cuts the 60- and 50-degree lines at points which give the respective diameters as 4.5 and 3.5 inches; the angles together equal 110 degrees and the sum of the diameters equals 8 inches. With 2.25 we may have 18 teeth of 8 pitch; with 2.3 we may have 23 teeth of 10 pitch; with 2.375 we may have 19 teeth of 8 pitch; with 2.333 we may have 14 teeth of 6 pitch, etc.

The difference made by using, say, 2.375 instead of 2.25 would be that we should have different diameters and angles than the above, although quite correct. This is often helpful, as it enables an adjustment of the diametral pitch to suit circumstances.

In working out for 2.25 we should have Fig. 5 as before, making $F\,O\,B'$ equal 110 degrees, $B\,O, B'\,O$ each 2.25 inches, with $B\,A, B'\,A'$ at right angles produced to L, L'. Slide 8 inches of a scale along $A\,B$, $A'\,B'$ until the point O be cut, then draw $A\,O\,A'$ and $O\,L'\,L$ at right angles. $A\,O$, $A'\,O$ without adjustment will be our diameters, which by measurement are 3.5 and 4.5 inches, with respective angles of 50 and 60 degrees. Checking the angles by calculation, we have:

$$\text{Cos. } \alpha, \text{ cos. } \alpha' = \frac{2.25}{3.5} \quad \frac{2.25}{4.5} = .6742, \ .500$$

and the spiral angles are 50 and 60 degrees, respectively.

$$\text{Lead} = O\,L \times \pi, \ O\,L' \times \pi.$$
$$= 2.93 \times \pi, \ 2.6 \times \pi.$$
$$= 9.22 \text{ and } 8.16 \text{ inches.}$$

Diameters = 3.5 and 4.5 inches.

Number of teeth, 18.

Diametral pitch, 8.

The same method may be applied to worms and worm-wheels, especially when the angle exceeds 25 degrees.

Thus it will be observed that by means of a spiral-gear diagram we have obtained the full data necessary, without adjustment and with the exclusion of laborious calculations.

The truth of the result depends upon the accuracy of the drawing, it being advisable to draw to as large a scale as convenient.

Saltley, England.

Hugh Elmer Clark, of Rochester, N. Y., noting our abstract of President Freeman's address on the saving of lives from theater fires, sends us an account of his lock for the doors of theaters, which is so arranged that while it securely locks and bolts the door from being opened from the outside, it is readily opened from the inside by a push exerted against a plate connected with the lock, and in such a position that it would naturally be pushed against by anyone attempting to emerge from the door hurriedly. It seems that it has been adopted in a number of places and has worked well.

What you are will show in what you do.

Automobile Construction—IV.

BY F. C. MASON.

THE REAR AXLE.

This part is illustrated in Fig. 10, and although in construction it does not, perhaps, represent the highest state of the art, it makes a good, serviceable axle and one which is easily machined.

The axle case is made of seamless steel tubing and the gear case, either a steel casting or malleable iron, should be brazed to the tubing. If you do not have the facilities for brazing, the gear casing can be screwed tight on the pipe and pinned through.

The brakes are of the Raymond type and will be given in detail later. The bevel-gear drive and differential are shown enclosed in their casing, sections and side views of which are given. As the differential is somewhat of a mystery to the laymen, I will describe its action and use:

If both rear wheels were rigid with the axle, in turning corners the one on the outside would have to slip, owing to the difference in inner wheel and outer wheel radius. It would not take many corners to ruin a pair of tires.

The type of axle shown is in two pieces, and each side is driven by a spur gear, A or B. These gears are enveloped by case C, which is bolted to drive gear D, the latter gear and the case turning on the axle. The gear case contains six pinions which mesh in pairs as at E, and also mesh with the axle-driving gears. These pinions are 3½ inches over all and have a tooth flank 2¼ inches long. They are put together with the gear ends opposite and the outer ends mesh with the axle gears, forming a reversing train; consequently it would be possible in turning a corner for

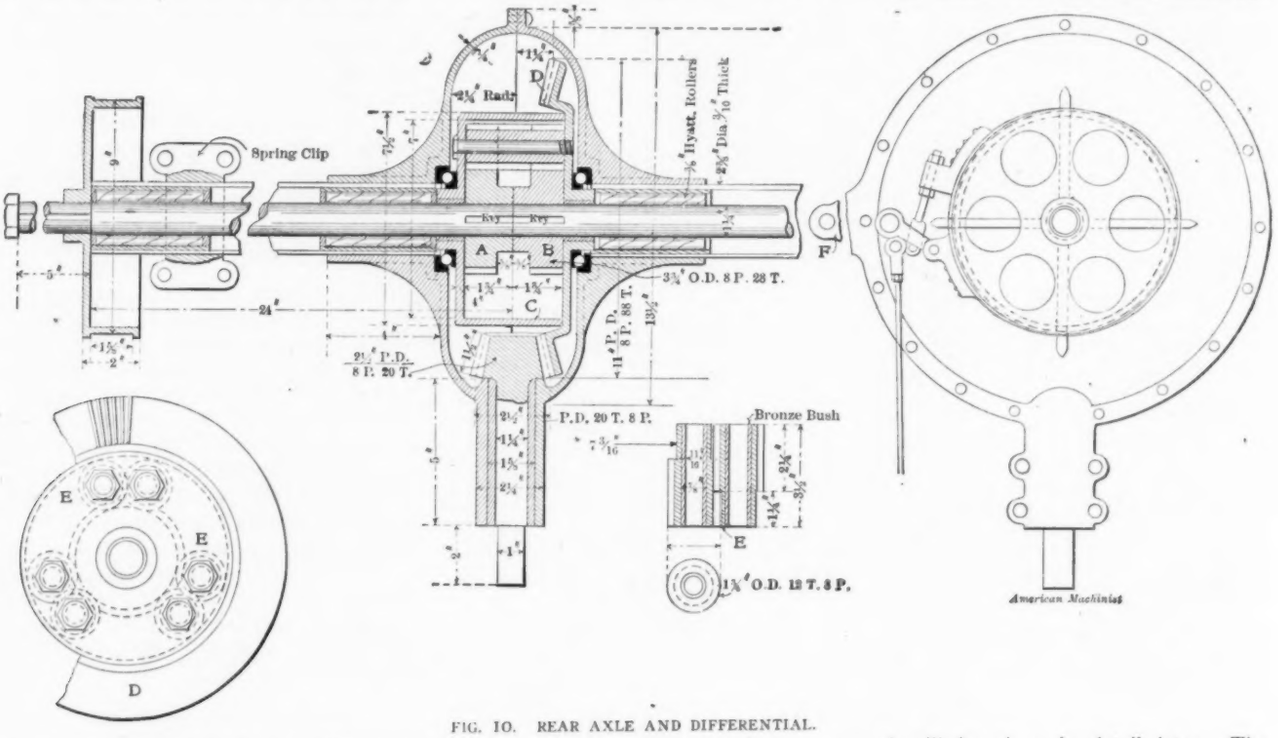

FIG. 10. REAR AXLE AND DIFFERENTIAL.

the inner wheel to stand still and the outer one to complete the circle.

The bevel gears should be made of machine-steel forgings, but a steel casting for the large gear would do as a compromise. The differential case can be made of steel, malleable iron or brass.

The axle gears and pinions must be of machinery steel, and it is advisable to case-harden them The pinions are bronze bushed. Ball thrust collars are shown, but fiber or case-hardened washers can be substituted. The spring clips should be brazed to the axle, and may be malleable iron or steel castings.

In going over rough places the springs will have a tendency to give the axle a whipping motion and therefore the axle must be supported. Lug *F* on the axle-gear case forms a means of attaching the supporting radius rod. This support should have a double-acting spring balance, the purpose being to keep the axle as near normal position as possible.

THE STEERING GEAR.

The steering gear, Fig. 11, is an original design, and makes a very neat and substantial job. It is easy to make, as the nut-and-lever case is cast in one piece, of aluminum, brass or gray iron.

The only difficult job on the device is the screw and nut. In making mine I evolved the following process: As the screw is 1½ inches pitch, I had no way of cutting it on an ordinary lathe without making new change gears. I made a thread cutter for the milling machine and cut the screw, doing the job in 45 minutes.

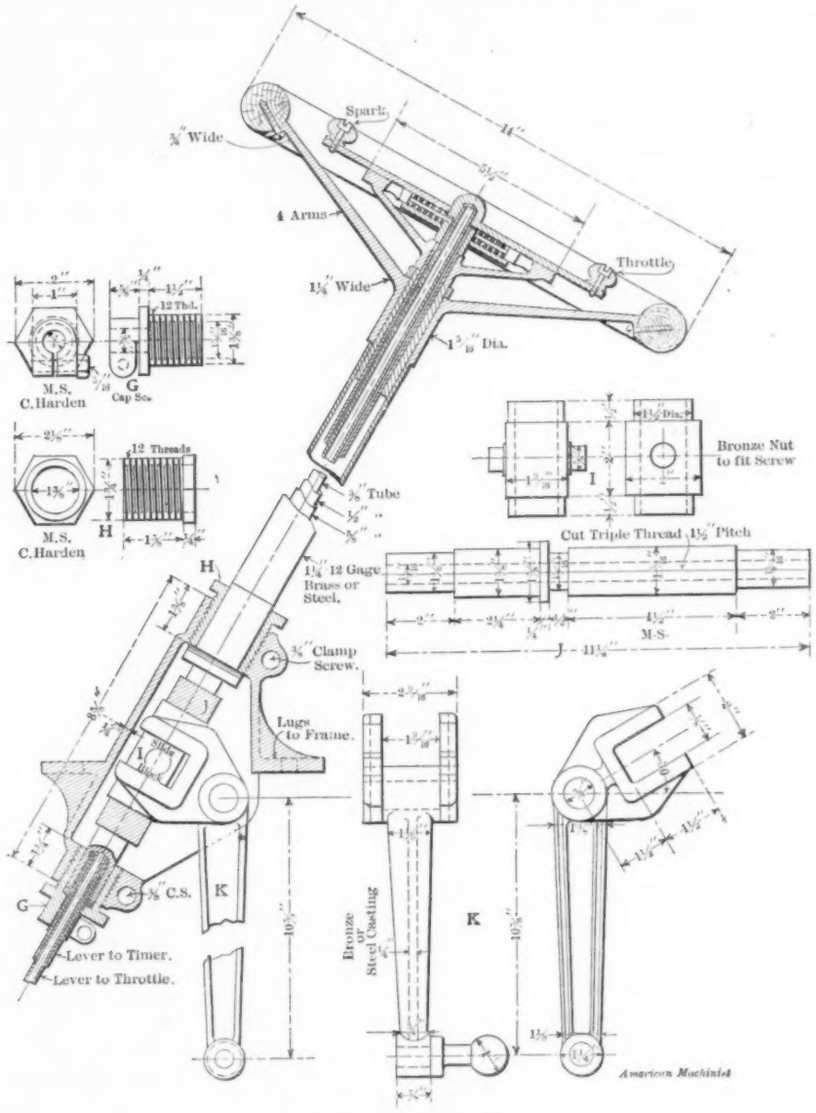

FIG. 11. STEERING GEAR.

The next proposition was the nut, and as the bore of this nut was only 15-16 inch and the thread triple, it will be readily understood that it was no lathe job. I made a wood pattern the duplicate of the nut and screw put together, took the pattern and screw to the brass foundry, used the cut screw for the core and cast the nut. We smoked the steel core before putting it in the flask. After casting, the nut screwed off easily and was a good job.

The drawing gives a sectional view of the assembled steering gear and shows most of the details. Part *G* is the lower screw bearing and also acts as a clamp nut to hold the spark and throttle quadrant in position. *H* is the upper screw bearing; *I* is the bronze nut for the screw; *J* is the screw. *K* is the steering lever, which is connected by a distance rod to the front axle steering levers.

The 12-gage brass pipe connecting the steering wheel and screw can be fastened very readily to the screw and the wheel bushing by sweating with first-class solder. If the job is done right I believe it to be amply strong and durable.

The spark and throttle quadrant is beveled on the inside to about 15 degrees and turned smooth, and the spring dogs in the levers conform to the bevel surface, thereby giving a frictional contact on two sides of the quadrant and doing away with notching. By this means you can get a much finer adjustment of the throttle and spark control.

The wheel spider, quadrant and spark and throttle levers are made of hard brass; common brazed tubing is good enough for the telescopic tubes for the throttle and spark control.

One of the interesting things spoken of by Professor Wood, of Johns Hopkins University, in his lecture delivered at the New York meeting of the American Society of Mechanical Engineers, related to the reflection of sounds, or the echo thrown back by surfaces arranged at regularly varying distances from the source of the sound; such as for instance, a high flight of stone steps. It is, of course, understood that the pitch of a note depends upon the rapidity of the vibration of the air and of the ear drums accompanying the note. It follows from this, as Professor Wood pointed out, that if one stands in the right position before a high flight of stone steps, and if he then stamps his foot upon a stone pavement, this sound will be thrown back or echoed from the vertical surfaces of the steps and will reach the ear of the hearer as a series of vibrations, each separated from the other by the amount of time required for the sound to travel twice the distance from one vertical surface of the steps to the next, the result being that the original sound of the blow of the foot upon the stone is reflected in a series of rapid vibrations, and produces a very high-pitched note like the chirp of a bird. The professor said he had found a place in front of the high flight of stone steps leading to the library at Columbia University, in which this effect could be readily produced, and no doubt there are many broad, high flights of steps in various cities in which it can also be done.

A good lubricant for drawing sheet metal in a press is said to consist of one quart of whale oil, one pound of white lead, one pint of water, and three ounces of the finest graphite. This is well mixed and applied to the metal with a brush before it enters the dies.—*The Brass World.*

Molding Machine Equipment—II.*

BY T. E. VANDERSLICE.

There are many foundries throughout the country that have built their own molding machines and have done much to advance the art of molding by machinery, and their success has brought others to try the same thing, some of whom meet with fair success, while others are a rank failure. Many of these failures were due principally to the way the patterns are mounted on the machine. It matters not how good a machine a foundry may have installed, if the patterns are on wrong it is a hard job getting it to work profitably. Among the different foundries in which I have been employed, I have had an opportunity to see the various methods employed to mount a pattern, and have also met and conversed with different pattern mounters, some of them being very narrow-minded, never listening to suggestions from a foundryman. I believe I can safely say that fifty per cent. of the valuable points I have gained in this art have been the fruits of suggestions made by the molders. I generally make it a point to interest as many molders in my work as possible, and at times, when I have been "up against it," their friendship has been the means of getting me out of a hole. Not everything that they say is worth keeping, but all that is good is retained. Oftentimes the pattern mounter will ignore the molders because the molders do not give him any encouragement. It is natural, however, that the molder should not be willing to advance a line of work that is liable to take his job away from him. No, the first step must be taken by the pattern operator or mounter.

While the molders do not, as a general rule, know much about machinery, the same may be said about the pattern mounter; he, as a general rule, does not know the art of molding as a molder knows it, and so what the molder knows about molding is just what is needed to perfect most pattern mounters, and if they will but take the molder into their confidence there is hope of getting the desired information. I find it a good practice, when a new pattern comes into my hands, to consult the boss molder for his views and learn how he would or has been making it by hand; when this information has been noted, then I go off by myself and have a good think about it, often coming back to the molder to further consult him on special points where I think I could improve over his method, and in this way I have been able to reach the best way of mounting the job in a short time, which, once determined, all is clear sailing and merely a matter of time.

I know of one instance where a pattern mounter (of the narrow-minded type) in a neighboring foundry, who thought he was so far above the molder that it was not necessary to consult the latter, did all his own planning, ignoring the boss molder to such an extent that all the molders got down on him and did all they could to bother him. One day the superintendent brought to him a pattern which was a very crooked affair, to be mounted on a machine; so he set about having the patterns and plates made for the job, which, in due time, was accomplished, and they were fitted to the machine and sent to the foundry. A molder put on the job worked a day without much success, finding it very difficult to get a lift without a bar; and as to put in a bar would be doing more than was necessary in hand molding, after a while the pattern mounter was sent for. He spent considerable time over it, till at last, with the aid of several soldiers, he got it to lift off safely; he knew just where to set the soldiers, and so got a good lift, but when the molder went back to the machine to use soldiers he got a lift once in a while, as he was not so particular in setting in the soldiers. In that way the job went on for a few days, till the operator got so he got nearly every lift. That, however, was not the whole trouble, for setting in the soldiers took time and so held down the output of the machine to such a point that it did not turn out any more than was turned out by hand; so the superintendent brought in some outsiders, who were very well up in the art, and they all claimed that the job was not parted right. When the superintendent called the pattern mounter's attention to it, he endeavored to throw the blame on the molders, claiming that they held it back; this meant that the superintendent went for the molder, which brought all the molders up to the fighting point and resulted in showing plainly that it was the fault of the way the pattern was mounted; so the superintendent discharged the pattern mounter, and another man was employed to fill his place, who soon had the same job mounted again, but parted as the molder had it. The lifts were made without any soldiers, and all hands went in to make it a success.

A JOB OF PATTERN MOUNTING ILLUSTRATED.

Another job that this new pattern mounter made on a machine came to my attention while passing through the foundry, and, believing it would be interesting to the readers of these articles, causes me to write it up and illustrate it by means of Figs. 1 to 9, the first showing the casting to be made.

The parting line for this job can be traced on the various figures as follows: Starting at the end of the pattern and with the cope section shown in Fig. 6, *K* represents the core-print in the end of the boss *E*1 of Figs. 5 and 6. *K*1 represents the parting line along the center of the boss *E*1 and core-print *K*, and this straight line continues beyond the circular outline of the boss *E*1 about ¼ inch on each side, so as not to leave a sharp corner down close to the pattern. From the ends of this straight line *K*1 start the lines *K*2 and *K*3, which form the parting for the remainder of the end of the pattern. Part of these lines, *K*2 and *K*3, represent a cavity in the plate *O*, and the remainder represents the building-up block *T*, all as in Fig. 6. A plan view of the end of the pattern and plate can be seen in Fig. 7; the cavity in the stripping plate is represented by the space in between the lines *T*1, *T*2 and *T*3, and the line *T*6 which surrounds the core-print *K* and the boss *E*1, is the beginning of the rise of this parting line up to the lines *T*1, *T*2 and *T*3; it stands away from the core-print and boss about ¼ inch. If the lines *K*2 and *K*3 came close up to the pattern there would be left a sharp corner of sand that would be very liable to crack and shove out of place, and drop into the cavity made for the iron to run into when

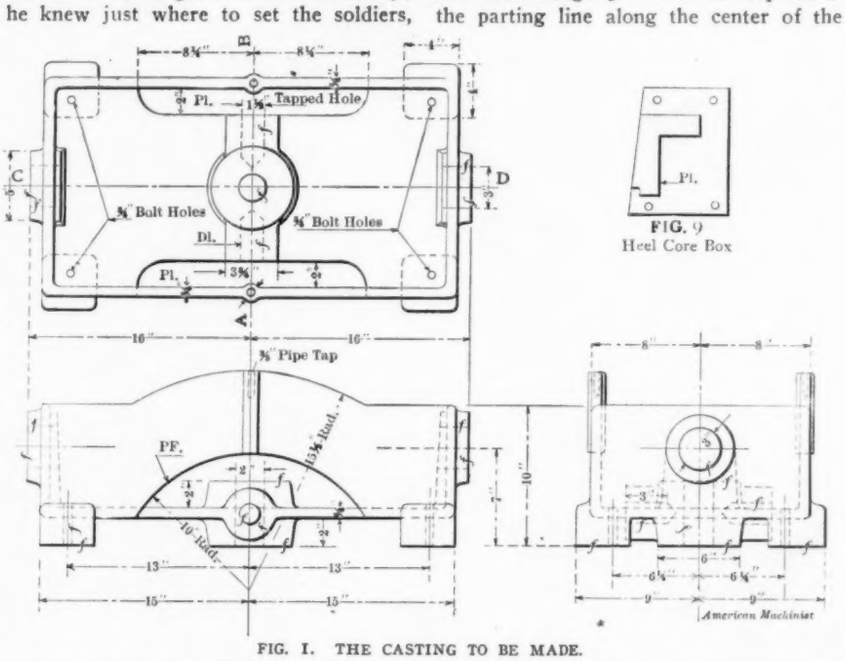

FIG. I. THE CASTING TO BE MADE.

FIG. 9
Heel Core Box

*For previous article, see page 624.

the mold was closed; this is a point in practice that is watched by all successful pattern mounters to insure good work.

Both ends of this pattern being alike are therefore parted alike, so from the building-up blocks on each end of the pattern, the building-up block drops again on the front and back of the pattern below the top face of the stripping plate *O;* this drop forms a pocket in the plate, and is represented by *F* in Fig. 5. The arc *F* is the same as the arc *P* of Fig. 4, and both together form the arc *P F* of Fig. 1. The hole *D*1 of Fig. 1 is partly cored out, which is accomplished by means of a heel core *E* of Figs. 5 and 6. The section of the casting that this hole must come in is designated by *D,* and its face sets in from the outer face of the pattern about 2¾ inches, thus making it advisable to make all the face of the section *D* in the cope; so the building-up blocks *P,* in Figs. 2 and 3, are made to fill the space *P*1 of Fig. 1. This arc then conforms to the arc *P F* of Fig. 1, and also to the arc of section *D,* better shown in Fig. 4. From these building-up blocks the form is transferred to the cope plate forming the cavity *F* of Fig. 5, and *L* of Fig. 6. The shape of this pocket is better shown in Fig. 6, and runs as follows: down the slanting surface *L* to the flat of the pocket, then up the line *L*2 to line *L*3, and up that line to the top of the pattern. On the face of *D,* which is represented by line *L*3, is fastened the heel core-print *E,* which, of course, has to conform to the shape of the sand pocket of the mold on the under end of the print, which has a special cavity made for the core. A plan of the core-box for this heel-core can be seen in Fig. 9. If the special cavity *P*1 were not made it would mean that the core must be anchored in the cope; as this takes time and should be avoided, an extra lug, *P*1 of Fig. 2, is placed on the top of the building-up block *P* in the correct position to allow the core to set in the proper place in the mold. This completes the description of the parting line on the outside of the pattern and the pocket *P*1.

All of the partings on the inside save the block *P* are on one level; this level being represented by the top face of the stool strippers *K*1 (Fig. 4), which, as can be seen, come up to the fillet of the outer wall and the center hub *O*1 of the pattern, and as the section *D* of the pattern rises up to this level *K*1, it means that there are two separate stool strippers *K*1 for this job, one on each end; these stool strippers are suported in place by stools *J* of Figs. 2 and 4; as all of the inside of this pattern is in the drag, a better view of the stool stripper *K*1 can be seen in Fig. 3, which is a view of the parts as the pattern is drawn through the stripping plate. This completes the description of the parting line on the inside and the outside of the drag pattern.

The cope pattern shown in Figs. 5, 6, 7 and 8 has four extra stool strippers not yet mentioned. These stool strippers are shown in Fig. 5 and designated by letter *N*1, and the stool by *N*. A section of the stool is also shown. The plan of the pattern at *N*, where the stool strippers come, is shown in Fig. 7, which shows the opening for the strippers *N*1, this opening being designated by the letter *R*. It will be noticed that it takes in two faces of each lug *J*, the outer faces of *J* being stripped by the building-up block *T*. To get a better view of the shape of the inside of the pattern where the stool stripper *N*1 comes see Fig. 8; this is a cross-section on the line *E F* of Fig. 7. The opening *R* is cut clear through the pattern, but at the side near to the outside of the pattern, where the metal is thin, an

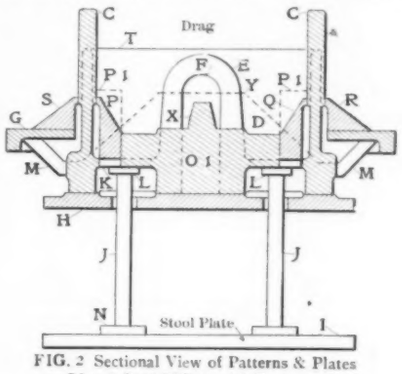

FIG. 2 Sectional View of Patterns & Plates on Line A-B of FIG. 1 with Patterns Up

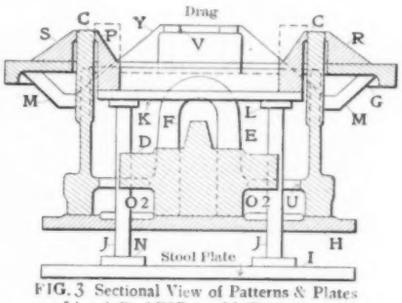

FIG. 3 Sectional View of Patterns & Plates on Line A-B of FIG. 1 with Pattern Down

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extra amount of metal is left at the bottom of the opening to strengthen the pattern at that point. This extra portion is designated by *Q*, and, as will be noticed in the cut, it is beveled off about 60 degrees; this bevel will allow any sand that may fall within the opening *R* to slide out of the opening and through a like opening made in the pattern plate where the two plates come together. There is a hole in each lug *J* that is desired to be cored. A print is placed on the pattern in the correct position on each lug of both cope and drag sections of the pattern; the print on the cope is designated by *C*1, while the print on the drag is not shown, as there are enough confusing lines as it is, but it is plain to see that they must be placed on that section of the drag pattern that represents the lug corresponding to the lug *J*. The center section of the drag pattern designated by *D* is a loose piece and is fastened to the stripipng plate *H*, as will be seen in Figs. 2, 3 and 4. This section *D* has a core-print in the center face of the top surface, designated by *X*.

CONSTRUCTION OF THE PATTERNS FOR DRAG MACHINES.

Starting with the drag which is shown in Figs. 2, 3 and 4, Fig. 2 is a transverse section on line *A B* of Fig. 1, while Fig. 3 is a similar section, differing in that the patterns are stripped down through the stripping plate, giving a better view of certain parts. Fig. 4 is a longitudinal section on the line *C D* of Fig. 1, Fig. 1 being the casting to be mounted on the machine. It will be noticed that the crookedness of the parting line will make it necessary to do some babbbitting, so, as iron patterns are made for the job, it will be necessary to make all new patterns and in two sections, namely, drag and cope. The casting being 32 inches long by 18 inches wide and having cored holes on each side and end, makes it necessary to make it in a flask of iron to the size of 44x24 inches, with an 11-inch drag and a 9-inch cope, this flask having bars in it to fit the pattern. In the construction of the master patterns for the drag-machine pattern ⅛-inch machine finish is allowed on such portion of the casting as can be machined, while at all other points a file finish only is allowed, besides the double shrinkage. The outer section of the drag pattern will be like a large frame, and so it would be advisable to put several braces on the pattern for the purpose of keeping the pattern straight while being cast; these of course will be stopped off in the mold very carefully so as to leave as perfect a casting as possible; the greatest section of the pattern should be in the drag, so as to produce a clean casting. It would not hurt if 3-16 finish were allowed on the bottom of this casting, as if there is any dirt at all it will come there and can be planed out.

All around the outside and the inside of this section of the pattern and ¼ inch below the parting line the pattern should be cut under about ⅛ inch on both inside and outside, making the thickness of the casting at this point ¼ inch smaller when this section of the pattern is finished to size; this will leave ½ inch of metal on the under side of the casting, into which will be tapped several ⅜-inch holes for binding it to the pattern plate *H;* while at each end in the center will be much more stock, where a larger tapped hole can be made if so desired. The total length or depth of this drag pattern is made according to the depth of the pattern-plate support of the molding machine. In this case a special machine was made in the shop where this job is working, and the depth of the pattern-plate support is 3¾ inches from or below the stripping-plate support, the section *D* of the pattern being made separate with a machine finish all over it. The pattern plate for this job was made to fit the machine and thick enough to prevent it from springing when

a mold was being made of the pattern. The interior of the pattern plate was cut away as much as possible, leaving a strip along the center from front to back to support the section *D*, and on the top face of this pattern plate was left a finishing pad, where the pattern rests, as well as a pad on the under side, where the plate was finished; the stool plate was a plain flat plate planed off on top and bottom surfaces.

CONSTRUCTION OF THE COPE PATTERN AND PLATE.

A pattern is made with all the remainder of the pattern not made on the drag machine, and as the largest portion of the pattern was made on the drag machine it means that a large area has to be covered to get a small portion of the casting print in the mold, and as the cope machine is similar to the drag it will take a deep casting, so to lighten this a large pocket, designated *I* in Figs. 5 and 6, is cut out in the center of the cope section of the pattern from the under side. The core-prints *C*1 and *B* are put in the casting when finished and fitted to the machine. The cope pattern has four pockets cut in it at each corner for the stool strippers *N*1 to fit in. A file finish is left on the section to be fitted to the stripper, and ¼ inch below the top surface of the pattern the pattern is cut under, the same as was done with the drag pattern below the parting line, only on the cope pattern outside, cut it under ⅜ inch instead of ⅛ inch.

While the master patterns are set up on a board, a temporary block is made to represent the stripping plate, its top surface coming at the same height along the side of the main pattern; then with this block resting beside the pattern, where the different building-up blocks come, the latter can be formed and fitted to the sides of the pattern while setting on this temporary block. A file finish is allowed on all parts save the under surface that rests on the top of the stripping plate, and a machine finish at this point. When the building-up block is such a shape that it cannot be set up in a shaper very handily, then several feet or lugs can be cast on the uneven surface so the block will set up even for finishing; when the bottom surface is planed off, then the feet can be sawed off and dressed up as intended around the pattern proper. In making the stripping plate for the cope and drag patterns, the outline of the patterns can be scribed on the face of the plate; a center line on the plate will enable it to be located centrally, or, as it should be, on the face of the plate; this center line will be the guide on both plates for locating not only the patterns, but the building-up blocks and the flask pins and bushings. The location of the building-up blocks should be scribed on the side of the pattern, so that the same location can be scribed on the stripping plate, then the building-up block can be fastened to the stripping plate at this determined point, and the two stripping plates (cope and drag) can be placed face to face, with the center lines of the plates matching up with each other. An opening is cut through the plate, so the building-up block will pass through it, allowing the two plates to come together, the two plates being turned so the building-up block will be seen protruding up through the plate. Out of another block cut a cavity that will be ⅜ inch larger all around than the building-up block, and cut and fit this last block to the under side of the plate, with the hole cut in it, to allow the building-up block to stick through. This cavity, when fastened to the stripping plate, must stand away from the building-up block about ⅜ inch; this ⅜-inch space is to hold babbitt and is not to be finished save the drilling of several holes. This same method of fitting the building-up block and cavities to one another can be applied to all building-up blocks on the job, and it will prove a cheap and quick way of accomplishing it. All these plates and building-up blocks when finished are sent to the foundry for the desired amount of good castings. The building-up blocks are not made fast to the plates till the top surfaces of the plates have been finished. The castings should be pickled and then sent to the planer and finished according to drawings; they should then be sent to the drill press and drilled according to the molding machine jig to fit the molding machine. Then comes

FITTING AND FILING OF THE PATTERNS AND PLATES.

One pattern should be filed on its outer face to the true shape and size according to the drawings. In this case the cope section of the pattern will be a good one to start with, as it has a good flat surface on the face of its four lugs (*J* of Fig. 5) to set it against an angle plate on a planer, in order to plane the sides of the pattern and the end, which is done with a slight draft. The top face of this pattern can be planed as well as the bottom; then the patterns can be removed from the planer, and the drag pattern can be planed on the under surface; then the two plates can be placed face to face, and while in this position they can be firmly clamped together and both set up in the planer again, and the sides and ends of the unfinished section (drag) can be planed as was the cope section. The inside of the drag section can be finished up with a file as smooth as possible; if a good casting was obtained then there will be no trouble in getting a nice finish on the inside of the pattern. When both patterns are finished, then prepare to fit both patterns through the plates; this can be best done by laying off on the top surface of the stripping plates the center line which passes through the flask-pin ears, in this case coming directly in the center of the stripping plates. After determining how the pattern should rest with this line, scribe a center line on the bottom surface of the pattern that will

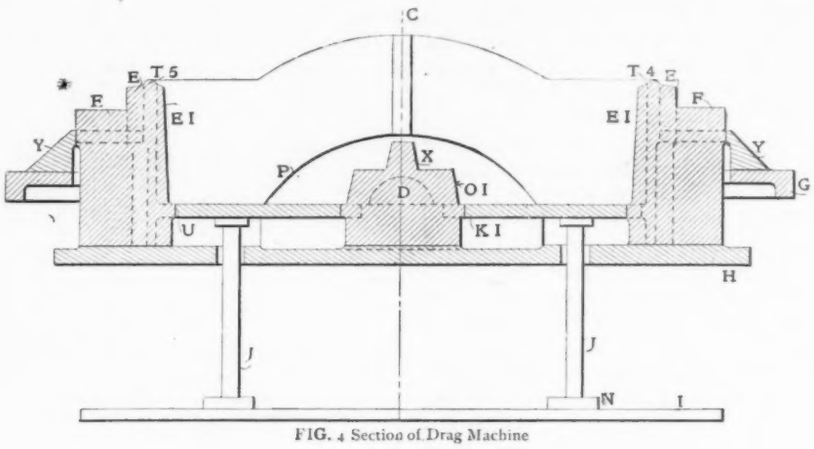

FIG. 4 Section of Drag Machine

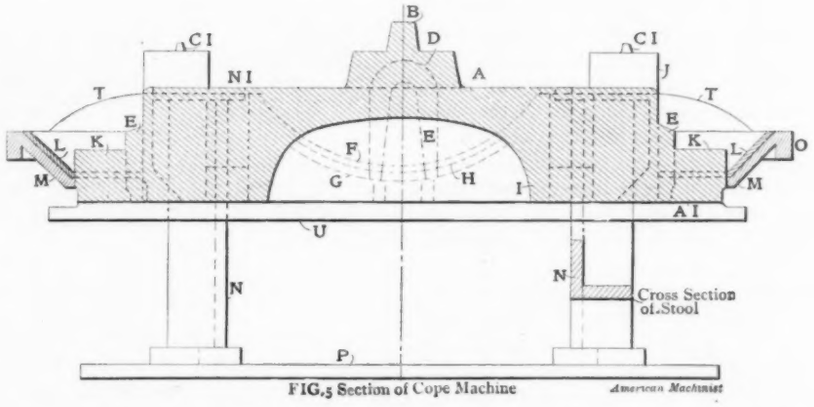

FIG. 5 Section of Cope Machine

match up with this center line on the stripping plate; then, as the underside of the pattern is below the full size of the pattern by ⅜ inch all around, this will allow it to set down through the opening of the plate resting on the ledge of the pattern and the face of the stripping plates; from that position it can be slipped to the exact location, and while resting correctly, a line can be scribed on the face of the cope stripping plate to the true outline of the cope pattern; then with the pattern removed, file out the plate to this line. If there was a section of the stripping plate cut away back in the master pattern, directly under this section, that now has to be dressed out, so as to leave not over ¼ inch of metal to file out; it will shorten the time of dressing out the plate to the size of the pattern. In filing out this plate it is advisable to file it so that the underside of

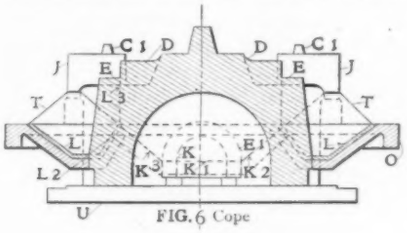

FIG. 6 Cope

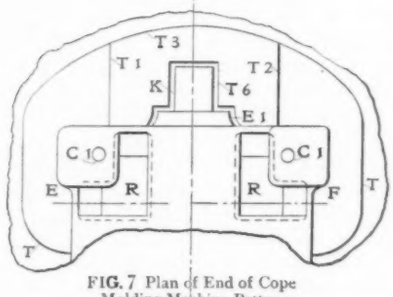

FIG. 7 Plan of End of Cope Molding Machine Pattern

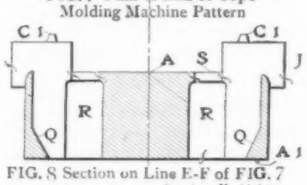

FIG. 8 Section on Line E-F of FIG. 7

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the openings of the plates will be up to size before the top face is, for then, with a little draft that was allowed on the sides of the pattern, the pattern can be placed under the opening and worked up through the opening till its sides come in touch with the sides of the stripping plates; then by red-leading the pattern and working it up and down through the opening, the red lead, where the pattern and plate come together, will show on the sides of the stripping plates, and by dressing off these points the pattern will gradually come up through the plate to its proper position. When the cope stripping plate has been filed to size, the flask pin-holes can be put in the plates on the center lines and the two plates put together true with these lines and holes and firmly clamped together. It is customary to make a set of steel studs to fit these holes, which studs will prevent the two plates from shifting. While the two plates are in this position the unfiled (drag) stripping plate can be dressed down to the same size as the cope plate, and the location of the swell *C* of Fig. 2 can be laid off on the side of the plate and dressed out.

The drag pattern can now be set under the stripping plate and worked and fitted up through the stripping plate, as was the cope pattern and plate, then the cope and drag patterns made fast to the tops of the pattern plates *U* and *H* of Figs. 5 and 4. The inside edges of the opening of the drag pattern were being dressed out square, prepare to fit up the interior of the drag section by finishing and locating the hub *D* of Fig. 4; then the stool strippers can be dressed to fit the opening between the hub and the outer shell of the pattern; when fitted finish off the ends of the stools *J* to the proper length to support the strippers at the correct position around the hub *D*. These strippers *K*1 do not fit close up to the sides of the pattern, but stand off to the edge of the fillet, and when working prevent sand from falling down from the sides of the pattern as the pattern is drawn downward; the depth of the inside of this pattern and the size of the fillet makes it possible to have the strippers away from the sides of the pattern. When the strippers are finished, proceed to dress up the building-up blocks *P;* these, as said before, take in the opening *P*1 of Fig. 1 and rest on the top face of the strippers *K*1 and are fastened with screws and strengthen the strippers in their position with the aid of the four stools *J*, Figs. 2 and 4. There are two blocks, one on each side of the pattern, and on these blocks are made and fastened the two additional pieces for acting as core-prints to the heel core *E*.

The next step with the drag pattern will be to fit the building-up block *Y* of Figs. 2 and 4 to the plate at the end of the pattern. These blocks fit around the core-print *F* and the boss *E*, and up against the end of the pattern; and as there is a cavity in the stripping plate at each corner, this building-up block will stick out over the edge of it, which will do no harm. When the two building-up blocks are fitted to the pattern and made fast to the plate, then proceed to drill the nail holes in the babbitted area and drive in the necessary nails close down to the casting, leaving just enough for the babbitt to run under them to hold fast. Then proceed to fit up the building-up blocks *S* and *R*, which fit on the drag plate close up to the side of the pattern and which fit the arc *P* of Fig. 4. When this is completed, fit up the building-up blocks *T* which surround the corner of the cope pattern (see Figs. 5, 6 and 7). These blocks will also lap over the edges of the cavity made in the end of the cope plate, but like the block *Y* it does no harm. Drill and drive nails in the babbitt cavities in the cope plate and prepare to pour them, by drilling through the bottom of the cavity a pouring hole (about a ⅜-inch hole will do), then by the removing of the heel core-print from the face of the section *D* the two stripping plates can come together. Remove the drag plate from the machine and set it down over the top of the cope pattern on to the cope plate and proceed to make a pocket around the pouring holes for the cavities in the drag plate, which are to be made to match up with the building-up block *T* on the cope plate. Before pouring clamp the two plates firmly together to prevent them from swelling. When the babbitt has set, take a cold chisel and cut the pouring gate off flush with the casting, and remove the two stripping plates to the other machine (drag). And right here, if the outside swell of the casting of point *C* of Fig. 2 were not removed the stripping plate (cope) could not slide down over the outside of the pattern; so remove the small piece on the side of the pattern and slip the stripping plate down on to the drag machine and pour them in the same manner as was the first plate. When set remove the plates and dress off any imperfection on the face of the babbitt; try them together again and where a swell shows in the babbitt scrape it off till the two plates will set together. Then fasten the two side pieces on the drag pattern, and the filing and fitting of the pattern and plates is completed.

The flasks for this job were all drilled and fitted by a jig, and the faces that rest in the machine were planed true. A master pattern was made and from this an iron pattern was made. A follow-board was fitted around the iron pattern. This made a good, substantial pattern that could be used at any time in the future when more flasks were wanted to take the place of any broken ones. The mold was handled with an air hoist, trunnions being provided at each end of the flask.

English As She Is Understood.

While waiting for a train in a terminal railroad station recently the writer saw a crowd gathered about two men who had been brought in to the city from a large steel works, and were being prepared for removal in an ambulance to the hospital. Catching a glimpse of one of them on a stretcher, with his leg apparently in splints, he remarked to one of the station baggage men. "broken leg?" That functionary replied quite seriously, "No, sir, it's just only fractured, they say."

Iridium, which is associated with platinum in the ore, is present in nearly all commercial platinum; it is cheaper than platinum and expensive to remove, so it is customary to leave as much of it as possible in the platinum. A very hard alloy, as elastic as steel and susceptible of a high polish, and of which springs can be made, is obtained by using one part of iridium and nine parts of platinum.

Machine-Shop Practice.*

BY G. M. CAMPBELL.

Good machine-shop practice may be said to be the arriving at the desired result at the lowest cost. Whatever can be done to cheapen production is a step forward. Very much might be said about rules and procedure for maintaining discipline, for the systematizing of output, for the installation of the piece-work system, or the many modifications thereto, and many other points; these, however, will be but briefly touched on. Attention will be directed chiefly to the equipment of the shops to indicate how very much can be done in the way of cheapening output.

The general management of a large machine shop is a subject in itself. The control over the shop should be very complete, and as much a one-man control as possible; not that one man should actually supervise the shop, but that he should control every department through competent assistants, each assistant or foreman having trusted foremen or sub-foremen under him. The utmost care should be taken to have all the work performed systematically, so that the time lost in handling work is reduced to a minimum. Again, the utmost care should be taken to turn out good work, for in the end any concern doing poor work is doomed to failure. Not only should the workmanship be good, but the parts turned out should all be to gage, within a predetermined limit of error, the allowable error being determined by means of limit gages.

The general scheme of handling the men, whether by day-work, piece-work, premium or other systems, is also a subject in itself. Each system has advantages and disadvantages. The men should be under careful supervision, but at the same time not watched as if they were trying to cheat the company. A speed foreman, or a man whose duty it is to speed up the tools to the proper point, is generally obnoxious to the men unless he has exceptional tact. The work can be done by a sub-foreman without the special title. The good will of the men should, as far as possible, be obtained by making the surroundings comfortable and healthy, and paying a good wage to keep good men.

An efficient toolroom is a requisite of a good shop. In it the tools should be kept in some good system, and should be kept always in the best of condition. The machines in this department should be high-class, otherwise their imperfections will be reproduced in the tools. In the larger shops it is the duty of the toolroom to not only see that certain tools are on hand for doing the work, but to see what jigs or other fixtures could be made to cheapen production, and to consider in general the best way to handle any special job.

*A paper read before the Engineers' Society of Western Pennsylvania.

The general-stores department is of unmense importance, for on it depends very much the profit or loss that the company will incur. The only possible way to prevent shortage, to reduce stock to a minimum, to keep an exact inventory of material on hand, to make certain that all outgoing material is charged to the right account, and to prevent delays in the manufacturing department by having ready to deliver the proper material at the required time, is to create a general store-keeping department for finished and unfinished material in charge of a good general storekeeper, and under him a sufficiency of clerks.

General management, tool supply rooms general-stores department, accounting departments are classed as non-productive, though, of course, without efficient service in these departments no works can pay. But the works themselves, the machines and men doing the actual labor, are where the money comes from, and it is there that the greatest reduction in cost must be made. In general it will be found that as the productiveness of the shops increases the non-productive labor will also increase. The great cost in all shops is the labor. Anything to cut down the relative cost of labor is a step in the direction of greater profit for the manufacturer, not necessarily to cut down the rate of wages, but rather the reverse, but to still further increase the output per man. The means for increasing the output may be taken up under these heads:

1. Multiplying tools.
2. Multiplying machines.
3. Improving the quality of the cutting tool.
4. Increasing the speed and ease of handling the machines.

MULTIPLYING TOOLS.

"One machine—one tool—one man," was the old rule since the operation of the first machine, and if some short-sighted trades' unions had their way, would still be in force. But such is no longer the case in live machine shops. Many single-spindled drills are, for special work, replaced by multiple-spindled drills, so that with one operation half a dozen or more holes are drilled, gaining very greatly in time and also in having the output absolutely interchangeable, a point of the very highest value. Single-headed planers are now the exception, except in small sizes; planers cutting on both the forward and return stroke have been used, but are not generally approved; plate edge planing machines cut both ways with entire satisfaction. Lathes also have multiple cutting tools, two, three and four. Locomotive driving-wheel lathes, for example, can have its two wheels and two bearings machined simultaneously, though duplex machines are the general ones used. Shafting lathes have usually three tools operating, gun lathes four, etc. Vertical boring mills have usually two heads. Turret lathes in their many modifications are a slightly different example of multiplying tools. The different tools are contained in one machine, but usually one tool operates at a time, the saving in time being effected by the extreme ease of changing from one tool to another. Screw-cutting machines with multiple spindles are now universal, so that the price per operation is reduced to a minimum—what a difference between the time when every screw was cut in the lathe, or by hand dies and present-day practice, when, for example, the operator has to thread 15,000 half-inch bolts in a day to make a living wage, as is the case in a Pittsburg shop! The milling machine is another example of duplicating tools, though in a slightly different sense. The milling cutter may have twenty to thirty cutting edges, each doing its fair share of work, and each is as distinctly an individual tool as the cutters in a boring bar, for example. Besides this a milling machine may have several heads. Milling machines have been productive of immense economy in the machine shop, not only in the decrease in time for the operation, but also in facilities offered for milling any kind of profile.

The multiplying of cutting tools in a machine will always be more of special than general application. The tendency of engineering practice is toward specialization, which is eminently favorable to the multiplication of tools.

MULTIPLYING MACHINES.

Many non-automatic manually controlled machines can be replaced by semi-automatic ones, so that one man can attend to two, three or more of these machines; and, one step farther, many non-automatic or semi-automatic machines can be replaced by automatic ones, for which the only attention required is the intermittent feeding of a new bar from which the screws, nuts, bolts, etc., are automatically turned out. But, in addition, besides the economy in it, there is the advantage of obtaining uniformity of product, and greater degree of accuracy. It is quite possible, however, to overstep the mark in installing automatic or semi-automatic machines, especially the former. They are only a paying investment when the number of pieces of one kind is large, so that the time taken to set the mechanism is small compared to the time the machine will be in operation. It is the balancing of capital and interest against saving in attendance.

Hand chipping should be replaced by pneumatic chippers, hand riveting by pneumatic or hydraulic riveters, hand filing by emery wheels, or portable electric grinders, portable drills to replace the old ratchet. Planers should be supplemented by milling machines to cut down the number of operations, lathes should be supplemented by grinding machines. Portable tools are usually thought of as being

small and light, and the majority of them are, but sometimes the work is so large that it cannot be taken to the machines, and consequently the machine has to be taken to the work, necessitating large and heavy portable planers, drills, etc., such, for example, as were used in the shops of the Westinghouse Electric & Manufacturing Company, at East Pittsburg, in machining large generator frames, some of these frames being laid out by means of a transit, as the ordinary method of straight-edge, square and level was insufficient.

In shops producing pieces by the thousand, such, for example, as bicycle factories, sewing machines, standard lathes and a thousand and one small articles of every description, the general practice is to install special machines for every individual operation, with always the result of cheapening cost.

Another imperative addition to all up-to-date machine shops is the traveling crane, which may be considered under the head of multiplying machines. Their value can hardly be overestimated; time and labor are saved to pay for the installation many times over. Practically all traveling cranes are electrically operated, and they are usually so equipped that there is motion in three planes at once. The use of the electric magnet for lifting in connection with these cranes should be made with reserve. It is, however, of much service in some places where the crane travel is small. Small electric or pneumatic jib cranes or suspended hoists should be installed wherever there is much lifting in one particular spot.

IMPROVING THE QUALITY OF THE CUTTING TOOL.

The discovery of the value of certain steel alloys is one of the greatest of the age in regard to machine-shop practice. Its value is far-reaching, not only in greatly decreasing the time required for an operation, but also in leading machine-shop men to investigate all connecting problems, such as the strength and better design of machines, the time required for handling and chucking the work, etc. If, under old conditions, a certain operation in a machine required three hours' time and one hour for chucking and handling, the idle time of the machine would be only 25 per cent. of the total; if the time of the operation were reduced by the use of high-speed steels to one hour, then the idle time would be 50 per cent., and some endeavor would undoubtedly be made to decrease time of chucking. There is a large amount of literature on the subject of these high-speed steels, and some of the showings are little short of marvelous compared with former practice. This is especially the case under favorable conditions in experimental demonstrations. Under ordinary conditions the results are less startling for the problem is not one of speed alone. High-speed steel may not always be a paying investment; for example, a light job requiring relatively little time for cutting compared to time required for preparing and chucking; or, again, suppose, under ordinary conditions, a man has all he can do attending to two machines, the cutting time of one being just sufficient for the chucking time on the other, then any decrease in cutting time would be of small advantage. In general, the new steels cannot be used to the limit; first, because the present machines will not stand it and the general tendency is to retain present tools, working them to the limit instead of at once scrapping them, and, second, much of the work will not stand it on account of special shapes. The old carbon steels give better results, as far as service is concerned, on very light finishing cuts. But on the larger work, shafting, guns, wheel turning, big planing operations, etc., the advantage is enormous. These steels have increased the output of railroad-shop machines 25 to 100 per cent., and in some cases even 200 per cent. There is still considerable experimental data to be obtained before the best results are obtainable from these steels, as the speed bears some relation to the depth of cut and the feed. The highest speed does not necessarily remove the greatest amount of metal in a given time. In general, a slower speed and heavier cut and feed are more efficient.

As a sample of what may be done in general practice, there is given a table of results under new and old conditions in turning a pair of locomotive tires. These are average results and are not for a particular instance. They were reported in the Proceedings of the American Railway Master Mechanics' Association for 1904.

OPERATION	TOOL STEEL Carbon Hrs. Min.	Air Hardening Hrs. Min.	High Speed Hrs. Min.
Setting tool, etc., throughout job	1 : 30	1 : 00	0 : 36
Grinding roughing tool	1 : 30	1 : 00	0 : 20
Grinding flanging tool	1 : 30	1 : 00	0 : 04
Roughing cut	8 : 00	5 : 00	1 : 00
Finishing cut	5 : 00	2 : 30	0 : 30
Flanging cut	2 : 30	1 : 30	0 : 30
Total labor	20 : 00	12 : 00	3 : 00

UNION PACIFIC RAILROAD SHOPS—COMPARATIVE TIME OF OUTPUT OF ONE PAIR OF DRIVING WHEELS.

As a parallel to this, the average total time in the shops of the Pittsburg & Lake Erie Railroad Co. per pair of wheels, under old conditions, using air-hardening steel, was eight hours; under new conditions, four pairs per day, or 2½ hours per pair. This is not meant for a comparison of the two shops, as conditions may not be the same. But not the whole of this improvement is due to the steel. Much of it is due to the better methods of driving and better facilities for handling the wheels. Many similar examples could be given. Later on in this paper reference will be made to some other results obtained in the P. & L. E. R. R. shops.

INCREASING THE SPEED AND EASE OF HANDLING THE MACHINES.

From the old hand-driven or foot-power tools to the line-shaft belt-driven shop was an immense stride, and as the machines themselves were improved so that some were all but human, it would seem that the limit had been reached. This was, of course, not true, even of the machine, and very much less so of the method of drive. The large belt-driven shops had become a perfect network of shafts, countershafts and miles of belting. These interfered greatly with the lighting and general cleanliness. Another great drawback was the lack of speed variation. The cone pulleys and back gearing, or its equivalent, could give as wide a total speed change as was desired, but the steps were too coarse. The average increase of speed by means of the cone pulley was 50 per cent. It may be assumed the average loss of sped would be 25 per cent., that is, one-half the speed increment. If now it were possible to decide, within 10 per cent., the speed a tool will stand, and if a method of control were put in to give that speed increment, then the loss of speed would average only 5 per cent. The advantage in favor of a close speed range would thus be 20 per cent., and if the average time the machines were running were 50 per cent. of the workman's time, then the net savings would be 10 per cent. If the mechanic's wages were $3.00 a day, the saving would be 30c. a day, or $100 a year per man.

The advantages of a motor-driven shop over a belt-driven one, are now so universally accepted that no argument is necessary. All the technical magazines have had frequent articles on the special advantages of electrically driven shops toward getting cleaner, better lighted, easier handled shops, and it would be but wasting time to repeat the arguments. The electric motor presents the opportunity of obtaining the close variations in speed that are so conducive to economy, and there are many different systems which will give, more or less accurately, the speed changes required. Until quite recently the multi-voltage system of control was undoubtedly the best, but owing to the great improvement or rather specialization of motors this system may probably be replaced entirely by the use of field-controlled motors giving wide variations of speed. Although many engineers approve the use of the motor, yet they restrict it to the larger tools; but if it holds good for the larger tools, why not also for the smaller? Do not exactly the same arguments hold? The value of the introduction of the motor was the reduction in the cost of labor. If any tool is driven by use of belt-driven cone pulleys, what difference does it make in the output of that machine whether the countershaft is belt driven or motor driven? None whatever. It may readily be proved that for any tool on which variation in speed is required, the installation of an individual motor drive with 10 per cent. speed increments will be an economical

investment. The time is coming when practically every metal-working tool, where speed changes or changes in material are required, will be, in an up-to-date machine shop, equipped with its own individual motor and at practically the price of the present tools. It is usually claimed that a group-driven system of motor drive is much cheaper than the individual motor drive, but such was not the experience in the shops of the Lake Shore Railroad, as was shown in an exhaustive report by the committee of the Master Mechanics' Association and published in their Proceedings for the year 1903. An extract is given herewith:

COST FOR GROUP DRIVING.

11 group motors	$4,550.00
Wiring 11 motors @ $18.30	201.30
Wiring 202½ H. P. @ $4.80	972.00
Countershaft, line belt, pulleys, etc.	6,667.00
Belting	3,881.00
	$16,271.30

ESTIMATED COST FOR INDIVIDUAL DRIVE.

103 motors	$12,340.00
Wiring 103 motors @ $18.30	1,884.90
Wiring 242½ H. P. @ $5.46	1,164.00
	$15,388 90

LAKE SHORE AND MICHIGAN SOUTHERN RAILWAY—COLLINGWOOD SHOPS.

"This result may be surprising, but it is even more favorable to the direct-driven estimate than it appears. The roof construction must be appreciably heavier when it is expected to support countershafting than would be the case if simply required to cover the building. Additional members must be incorporated, but this expense we are not in a position to estimate at present. Then no charge is made against belt-driven tools for belt shifters and the cost of applying the belting, which for 103 tools is quite an expense." On the other hand, the speaker thinks the estimate for the individual drive is somewhat low both in capacity of motors and cost of wiring. The whole report from which the above extract is taken is an excellent one and worthy of close inspection by anyone interested in shop equipment.

One argument often brought up against the old belt-driven shop was the great waste of power, and the same is brought up against the use of individual motors as against group driving, on account of the lower efficiency of small motors, but the argument is not worth considering when the total amount of the power consumed is taken account of. The cost of power is very rarely 2 per cent. of the cost of the output in shops of any size. Suppose by the strictest economy 50 per cent. of the cost of power could be saved, yet the net saving would be only 1 per cent. During the year 1904 the total cost for power at the Pittsburg & Lake Erie shops was slightly over one-half of 1 per cent. of the cost of the labor and material.

Some information concerning the motor-equipped shop of the Pittsburg & Lake Erie Railroad at McKees Rocks may be of interest. The shops are compactly situated and consequently direct current could be used to advantage; the voltage in use is 250. For machine work, the multi-voltage system of drive is used and with excellent results. The voltages vary by steps of 40 from 40 to 240, with intermediate and additional steps obtained by means of field resistance. The controllers in use have 21 steps in forward motion, giving approximately 10 per cent. increments. Individual motor drive was carried to a much greater extent than in any shop, previously put up, but experience has not shown that any mistake was made in so doing. In the machine shop only one small group of tools is driven from shafting. All the others have individual motors. The tools in the group above referred to are such tools as drill grinders, polishers, bolt-threading machines, etc. In the wood-working shops, however, group driving is the rule; individual motors are used only on the larger machines; in general, in machines of this class, no change in speed is required and therefore group driving is entirely satisfactory.

One excellent feature of the electric installation is the entire absence of exposed wiring, and yet every foot of the floor of the big machine and erecting shop, 172x530 feet, is accessible. This is accomplished by running a tunnel 3 feet 6 inches by 4 feet the full length of the shop, and from it branch ducts 4x12 inches from side-wall to side-wall every 5 feet 6 inches. These latter were made part of the floor and were put in practically without expense. All the wiring in these ducts was put in after the floor was put down, loricated conduit being used.

In order to protect the machine, not the motor, the motor is controlled through a fused switch and also a circuit breaker. Up to date there have been only three cases where the machine gave way, though all the machines have had severe work. The weak parts, chiefly gears, were replaced in these instances by heavier material, and no further trouble is expected. In obtaining speed variation, in a large number of machines it is impossible to obtain it entirely by the motor. Speed ranges of 50, 75 or 100 to 1 are not at all infrequent, such, for example, as changes given by the old triple or quadruple geared lathes. This is, in an electrically driven tool, taken care of by obtaining, say a 3 to 1 variation in the motor, and the necessary number of change gears, each increasing the speed in proportion of, say 3½ to 1. A very common method of obtaining these changes is to use sliding or rocking gears. This the writer considers bad design; nothing but clutches should be used, for otherwise it is impossible to change from one gear drive to another except when the machine is idle, and then on the heavier machines only with difficulty, whereas with clutches the change can be made without stopping the machine. In the Pittsburg & Lake Erie Railroad equipment this point was absolutely insisted on despite the severe opposition of every toolmaker. Magnetic clutches for the reciprocating tools were not used, as it was considered that the improvement in results would not be sufficient to warrant the expense, and also the clutches at that time were in a state of development. Better results may now be obtained and probably at lower cost.

The complete list of all motors installed numbers 83. This list of mtors shows sizes as follows:

Number.	Rating.	Total H. P.
1	2	2
6	3	18
6	4	24
11	5	55
3	6	18
16	7½	120
1	9	9
10	10	100
1	13	13
13	15	195
3	20	60
7	25	175
3	35	105
1	45	45
1	60	60
83		1,000

It should be noted that the rating is for full speed and voltage, not the actual horse-power obtainable at all times and not the horse-power required by the machines. The horse-power rating for the variable-speed machines would be only 40 to 50 per cent. of the motor rating. The other motors around the plant would add about 450 horse-power and the cranes about 250 horse-power, bringing the total motor rating up to about 1,700 horse-power. Of the 83 motors, 75 are used for individual drive and 8 for group driving, 5 of these 8 being in wood-working shops; 27 are constant-speed and 56 variable-speed motors. The total cost of these 83 motors was $20,275, or an average cost of $244.50, exclusive of mounting. The same motors could now probably be bought from 15 to 25 per cent. cheaper. The average horse-power of these 83 motors is 12.05.

During the year 1904, the average horse-power taken by all machine-tool motors was about 200 during working hours, but all the tools listed above were not in operation. The average power consumption at present is about 300 horse-power, or about 30 per cent. of the horse-power rating of the motors. During the year 1904, the average power consumption of the machine tools was 17.3 per cent. of the output of power-house; it was 38.71 per cent. of the total electric power; lighting was 24.9,, heating motors 23.78 per cent. The electric power consumption of the machine tools, including cranes and blast fan was subdivided as follows:

Variable speed tools	39.71%
Constant speed tools	26.80%
Blast fans	28.44%
Cranes	5.05%
	100.00%

The total cost of power for the machine tools, including the cranes, was $2,662.66; this does not include the maintenance of motors.

In addition to the shops being well equipped with motor-driven tools, there are at present in service seven cranes from

120 tons to 7½ tons capacity. Three more will be added shortly.

The capacity of the power-house for electric work is 600 kilowatts full-load rating, or 750 kilowatts, with 25 per cent. overload. There is space for one additional generator of 150 kilowatts capacity.

The following few items are given concerning speeds of cutting. These are not given as maximum and are not special tests, but are every-day practice, as previously stated.

Railroad shops are, in general, repair shops, so the weight of metal removed is not at all remarkable, compared to many tests which have been reported.

To show the excellent results obtained in the new shops the following figures may be noted. The shops were opened in February, 1904, but were not in full operation until some months later. It of course took some time to become used to new conditions, so that results for the year 1905 would probably show a higher increase over the year 1903.

No.	Machine Description.	Wt. Removed Lbs. per Min.	Speed Ft. per Min.	Material.	Remarks
10	Lathe	2.63	106	Gray iron	
10	"	2.33	44	Steel	
16¾	"	1.69	170	"	
13	"	3.43	43	"	
20	"	4.2	54	Wrought iron	
14	Wheel lathe	6.3	13.2	Steel	
23	" "	5.3	15.5	"	
51	Planer	3.2	30	Cast steel	
52	"	18.3	29	Gray iron	
62	Shaper	2.03	120	Brass	60 strokes, minute
39	Drill	0.52	74.5	Wrought iron	1⅛" drill
147	"	0.88	53.9	" "	1⅛" drill
33	Boring mill	1.1	59.5	Steel	

P. & L. E. R. R. CO.—MCKEES ROCKS SHOPS.—SAMPLE CUTTING SPEEDS.

Locomotives repaired	1903	64
" "	1904	145
Locomotives built	1903	None
" "	1904	10
New fire boxes	1903	5
" " "	1904	21
Cost of labor	1903	$216,472
" "	1904	235,871
An increase of only 9.5%		
Credit for outside work	1903	4,008
" " "	1904	61,516

The force of men is now 25 per cent. more than during 1903, but the output is very considerably greater. Formerly five to seven locomotives were overhauled per month, now from fourteen to twenty. Very much of the increase in number is due to the repairing of locomotives for other roads—Erie, Lake Shore, Pennsylvania and Union railroads.

The new shops are considered an excellent investment despite the heavy first cost, and it is estimated that they will have paid for themselves, including first cost and interest, in ten years or less.

DISCUSSION.

G. E. Freed—What I have to say will deal more with the handling of material and distributing it through the shop than with equipment. What I have in mind is to take the raw material in at one end and put it out finished product at the other.

I think the machine tools should be arranged so that the material as far as possible goes in a straight line. There should be no going backward. I realize that it is not always practicable, especially where shops are built up in the air and elevators have to be used; but in a manufacturing establishment, and that is what I have in mind rather than a repair shop, we should get all we can out of the appliances we have, whether they be men or machines, and in order to do that we must handle the material just as little as possible, because every time we pick up a casting and truck it around the shop or up an elevator it costs money.

I know in a great many instances it is customary to have a general storeroom, a general stockroom for the storing of castings and raw material; but then again I think there are instances where it is better to store the raw material where you are going to use it first. I have in mind a manufacturing establishment that has raw material all over the first floor, in bins handy to where it is going to be used. It saves a great deal of trucking, it saves a man's time going to the other end of the shop to get something to work on. His material is always at hand so there is a consequent saving of labor.

When that man is through with a piece have it ready for the next man, and so on as far as possible. I know I am treading on dangerous ground when I get away from the general storeroom, but there are certain lines of manufacturing that will admit of storing your raw material where it is going to be used first.

When the material is finished I would say, if practicable, have it handy to the assembling room or floor. Thereby the men get their pieces when they want them and do not lose time waiting their turns at the storeroom door or window. We should not lose sight of the fact that the machine shop is run to pay dividends, and we should avoid all extra expense possible. While the shop may not look as nice as we would like it, while it may not be arranged as nicely as somebody else would like to see it, nevertheless it is arranged suitably for our requirements.

In regard to tools, it would seem best to have a tool for one operation and keep that tool busy as much as possible. There are circumstances under which it would be better to have a tool idle six months in a year, and then have it the other six months when you need it very badly, instead of having a tool that can be changed or arranged for five or six different operations, for just as surely as you want it for one operation it is fixed for another, and then something has to wait.

James H. Baker—I fear that I differ from many of you, so much that I might be treading on dangerous ground—perhaps no ground at all—there might be nothing under me. But I am going to say just one or two things, not in relation to the machine shop particularly, but on the principle Mr. Freed spoke of, the distribution of material when getting it in.

I had a forge where we avoided many new ideas, and I am not ashamed of it because we made money out of it. To give you an instance or two from my experience there, in this forge we weighed our material on the cars as it came in, then from an elevated track alongside of the forge we dumped that material where we wanted to use it, and there worked it up without further manipulation, either literally or on paper. If it was cut to lengths for a certain hammer we unloaded it just as close to that machine as we could. And if they were forgings that needed no further work after coming from the hammer they were inspected, counted and packed right where they were made. Mind you, I like system, but that system where if one wants a thing you never have to look a second time for it. I have balance sheets and percentage tables of different works I have been interested in, and I have been in forges that were thought to be a great improvement on the one I have just mentioned, but I have not anything that shows near as low incidental labor expense as the one I have referred to, and incidental expense is that thing we are all trying to avoid in our business.

H. H. Anderson—It is possible that there are a number here who have had experience in high-speed steel. For myself I have had a good deal of experimental experience in the endeavor to find a tool steel that would cut high carbon steel. We tried various brands of air-hardening steel until we came to high-speed steel, where you have to heat the steel to such a point that it begins to flux. From these steels we have got good results.

G. M. Campbell—Carbon steel, the old steel that was in use for generations, was pure iron with a certain varying percentage of carbon in it. A step forward from the carbon is what is called air-hardening, or self-hardening steel. By using certain ingredients with the steel and heating that particular composition or compound to a certain temperature and cooling it, usually in air draughts, the tool would have a toughness, and, what is more, it would not lose its temper. The value of these steels is not in the trueness of their edge, or their strength, or toughness, but it is the temperature at which they work. The old carbon steels had to be worked at a relatively cool temperature, but a self-hardening steel could be worked at a very much higher temperature. Now come

what are called the high-speed steels, which when they are being heated for tempering are heated so hot that the surface will actually run, and unless you heat them to about that point you cannot get a good finish temper. In working with high-speed steels the general instructions are not to use them above a red heat. That seems simply absurd to speak about using a cutting tool to red heat. But high-speed steels will actually work until in darkness they will pretty nearly show red. That is where the time is gained. In taking a heavy cut in roughing there is an immense amount of heat generated that must be got rid of. Part of it will go to the tool because the tool is right at the point of generation of the heat all the time. And the advantage of these steels is in their ability to stand the high temperature thus brought about.

The new high-speed steel is not considered the best steel for some purposes; a light cut or finishing cut, for example. As good a finished surface cannot be got with high-speed steel as with carbon steel. But wherever metal has to be removed, wherever heat is generated, that is where they have the decided advantage.

Geo. H. Neilson—Not long ago, in the Pennsylvania Railroad shops at Altoona, I saw them flooding a cutting tool with a stream of water, and they claimed that the efficiency of the tool was very much heightened by keeping the heat away from it. The life of the tool was longer and they could do heavier work with it. I do not think that is a practice that is followed in very many works, but they do it there all the time.

G. M. Campbell—That is true with high-speed steels. It is simply necessary to keep down the temperature. A great many shops are using water simply for this purpose.

H. H. Anderson—I understand that at some shops, in boring shells, even with water running on the high-speed steel tools, it gets so hot that it shows a cherry red on the inside of the shell.

Geo. H. Neilson—Another point that is bound to come up will be the selecting of the various carbons in the high-speed steels to do various kinds of work, just as in the carbon steel.

A great many who make their living by selling high-speed steels will deny that, but I have made a great many tests, and you will find that the carbon that runs 0.8 will do work that a tool running 0.4 will not do.

At the Westinghouse Air Brake Co. they have a tool that will cut brass at any rate of speed they can drive it, but it won't cut gray iron. And the tool that will cut gray iron will not cut brass. The difference in the tools is only in the carbon. Everything else on analysis is exactly the same. But the range of selection will not have to be anything like as great as it is in carbon steel.

I have seen lathe tools run as high as 2.25 carbon. It is very hard to handle. I have a lathe tool that will run 1.20 or 1.30. That is what you will usually run up against. That is a very hard steel to handle, but, like everything else, if you get it just right it will do the work. A soft steel, even of 0.4 carbon, will not do the work. There is just the same thing in the selection of high-speed steels.

L. C. Moore—I am at a loss to see how you can have 0.8 carbon and run the heat up to cherry-red and at the same time run water on it.

Geo. H. Neilson—The influence of the alloy on the high-speed steel is in holding the carbon in solution and not letting it flow out. An ordinary carbon-steel tool would burn out very quickly, but with the alloy holding it in solution it will not get away from it.

H. M. Wilson—I think the steelmakers themselves realize that fact, because high-speed steels have to be made in different crucibles from ordinary carbon steel. They do not use the ordinary crucible, because it causes a variation in the carbon and affects the steel.

L. C. Moore—I did not know until tonight that carbon is an element in high-speed steel. I thought that the tungsten and the other elements were the ones that did the trick.

Geo. H. Neilson—I read in a paper a while ago that high-speed steel had absolutely no carbon in it. The paper was written by a man who had used thousands of dollars' worth of high-speed steel in his shop, yet did not know there has never been high-speed steel without carbon. The influence of carbon, from the experience I have had with it, makes almost as much difference in a high-speed tool as in a carbon-steel tool, and if anybody has had a different experience I would like to hear from him.

G. F. Freed—I have either been told or I have read in one of the circulars that high-speed steel is just as free from carbon as they can make it, depending on the alloy for its property, and that what carbon is in the steel is from the crucible or gets it during the process of manufacture, but they avoid it as much as possible.

H. H. Anderson—I think a great many agents in selling high-speed steels have declared that the great idea is to bring the tool in tempering to a flux so that the alloys would come to the cutting edge and eliminate all the carbon possible in the tool. They say they have it down to .4, but they do not claim to have excluded it entirely.

Geo. H. Neilson—I have seen an analysis made of nearly every high-speed steel put on the market up to within the last six months, and every one of them showed carbon and a strong percentage of carbon.

L. C. Moore—How do you account for the fact that with a carbon of .8 you can cut a locomotive frame and run cold water on the edge of the tool, and still have the tool stand? I mean with self-hardening steel.

Mr. Neilson—They don't let it get hot enough to crack it, is the only way I can explain it. The only place I have seen it done where I asked anything about it was at the Altoona shops, and they didn't have it anything like that hot, because the water turned on the steel did not steam at all.

L. C. Moore—I do not think it is always essential to a piece of steel that it should contain a certain percentage of carbon. I know the common idea is that if we have not carbon we have iron. Yet in my practice in my younger days, I have known many brands of steel that were absolutely free from carbon, yet we knew they were steel, as we term it. They were made up of a combination of elements, but we were never able to determine just what they were. No two chemists, making dozens of analyses from the same test specimens, would get an average of nearer than 8 and 20. Their variations would be that great in percentage. And yet these steels were so tough that you could do almost anything with them except cut with them. A cold chisel would cut it freely, yet you could punch a hole in it and draw two miles of wire through the hole without the hole giving way more than 1-1000 of an inch. I never was able to learn what the elements in it were, but there was not a trace of carbon in it.

Arnold Stucki—Mr. Campbell has mentioned day-labor, piece-work and the premium system. I would like to have the latter plan explained a little more in detail. We all know what day-labor does not do justice to either the man, the machine or the employer. The next best thing is piece-work. It is most satisfactory, inasmuch as the workman feels that he is working for himself.

But often it is impossible to adjust the price of certain work just right, and in order to protect the employer a certain limit is set for each man, above which he is not allowed to go per day. What is the consequence of this? It is natural that each man tries to get as high a rating for each piece as possible, and if he finds that he is going to overstep the limit, he either slacks off in his work or stores the surplus for a future "rainy day." In either case, the output of the machine is reduced, and even the "card system" does not remedy this.

For this reason the premium system has been introduced. It is the piece-work system, extended in such a way that the workman, after reaching the regular limit, is not stopped. Instead of this he gets a certain percentage of what he makes extra. This way the employer obtains the maximum amount of work which the machine is able to perform, and I know of cases where this system works very well.

G. M. Campbell—In general Mr. Stucki's statement is quite correct as to what the premium system is as it is ordinarily understood. There are different forms of it. Usually a man is guaranteed a certain wage, just the same as if he were working on day-work, and he gets that no matter whether he works out the amount of material stipulated or not. If, for example, he gets 30 cents an article and he has to put out 10 for a day's work, if he only gets out 9, that is $2.70, yet he gets his $3.00 because he is guaranteed that. But if he gets out more than 10 he gets a certain percentage of the excess, which varies in different shops, usually a certain percentage up to a certain overoutput and a certain other percentage beyond that.

In general all these schemes sooner or later come down to pretty near day-work. In a certain locality there is generally a certain price, which is more or less a living wage, and sooner or later, no matter what system is in force, it will come down to what is called a living wage. It comes about through new manufacturers. An old established firm, having a business, installs a system of premiums, and fixes certain rates. But another manufacturer comes in. He is not bound by that first rate, and fixes a lower rate to suit himself. If there is an abundance of labor that man with his lower price can put out a cheaper product, and the old manufacturer must meet the competition. So with all these systems; the men do not like them because they know they have to work harder to get a living wage.

L. C. Moore—I would like to ask Mr. Campbell if he does not believe that improved machinery and improved facilities have done more toward increasing production than premium systems and schemes of that kind?

G. M. Campbell—I think it is the case, though they all work together. The whole thing is so interwoven that it is pretty hard to pick out which is which.

G. E. Freed—My experience has been that the men prefer piece-work to premium-work. They are generally averse to taking one-half the increase; they want it all, and they prefer to stick right to the piece-work.

H. H. Anderson—Very frequently the quality of the work is neglected if it is possible to increase the output thereby, and the increase is at the expense of the machinery. They will strain every point to get the greatest possible output, and at the same time neglect the machine, which ought to receive the most attention to enable them to get the necessary work out, while with day-work you can rest assured that they will pay a great deal more attention to the machine than they would on piece-work, and the keeping up of their tools, etc.

Mr. Stucki—In regard to working two tools per machine, I fully appreciate what Mr. Campbell has said, and I wish to emphasize also that two tools are very much easier on the machine and enable us to do the work more accurately. It, for instance, is a well known fact that it is impossible to bore an absolutely true hole on a boring mill with only one tool.

For a similar reason the milling tools are gaining in favor every day. Besides this they are especially economical, because they never return, such as planers do, and this fact alone explains the great saving in time effected by milling tools.

The Growth of Forced Draft.

"Forced draft," said Admiral Melville in a recent paper, "dates back to Stephenson's *Rocket*, and its first use for marine purposes was by Mr. Robert L. Stevens on the Hudson River steamers in our own country prior to the Civil War. During that war Mr. Isherwood built a number of gunboats which used forced draft, but it had fallen into disuse until about 1882 for naval vessels, when it was introduced into the English navy and still later was applied in the merchant service.

"In naval machinery forced draft has been of the greatest possible importance because it has reduced boiler weights probably almost one-half. In the navy the natural limitations as to space and weight prevent the use of forced draft with very much economy of fuel. It is obvious that if the rate of combustion is increased from 15 pounds of coal per square foot of grate to 40 pounds, there ought to be an attendant increase of heating surface. In the merchant service, or at least in certain classes of vessels in that service, it is possible to do this, and in one of my annual reports I made a comparison between the boilers of a merchant vessel called the *Iona* and those of the *Baltimore*. In the *Iona* there were 75 square feet of heating surface for 1 of grate, while in the *Baltimore* the ratio was about 30 to 1; but had the *Baltimore's* boilers been designed with any such ratio, their weight would have been almost double the weight of all the machinery of that vessel as actually built."

Some Changes of Personnel in The Pennsylvania Steel Co.

H. H. Campbell has been appointed to the office of metallurgical engineer. He will occupy a similar position with the Maryland Steel Company and The Spanish-American Iron Company.

J. V. W. Reynders has been elected vice-president and will have full charge of all the Company's affairs at Steelton.

John W. Dougherty has been appointed general superintendent of the Steelton Works.

F. D. Carney has been appointed Assistant general superintendent of the Steelton Works.

Thomas Earle has been appointed superintendent of the bridge construction department.

Letters to the Editor.

Removing a Pulley From its Shaft Under Difficulties.

Why don't more machinists read the mechanical papers? In looking back over the past twenty years I can think of a number of cases where, had I not been a careful reader of the AMERICAN MACHINIST, I should have experienced difficulty in getting out of a number of tight places, one of which in particular, comes to my mind at this time.

A few years ago we were called upon to replace a length of 3½-inch shaft in one of our large State penitentiaries. On this shaft was a double-arm pulley, 6x3 feet. Several years before, the engineering force had tried unsuccessfully to remove this pulley, with the result that a key about 10 inches long remained in the hub, which was 20 inches long. We were told that this key could not be moved, but we had had experience with that brand of keys before. The shaft was of little value, and as time was worth a good deal, the first thing we did was to saw off the shaft by hand on each side of the pulley. This was necessary, as the shaft passed through the masonry piers, built to support a Corliss engine on the floor above. A vigilant official kept close tab on hack-saw blades, even to the pieces thereof, so that no convict could get one up his sleeve.

We started at 9 P. M., at 10.05 the shaft was in three pieces, and, with chain tackle, the pulley was hoisted to the floor above. We tried to start the key, but it refused to budge. We tried a 3-inch screw and nut, borrowed from the shaft-straightening press in the shop, with suitable rigging previously prepared, to force the shaft out, and we desisted only after breaking the nut; time, 1.30. We had no drill press in our own shop that would drill out the key or shaft, and the chief engineer said, "We will have to wait for daylight, take it up to the railroad shops, and put it under one of their big radials"—not a very pleasant outlook, as our prestige would suffer, and we had none to lose. The temperature (10 degrees below zero) and the delay stimulated effort to be exerted then and there.

The State machine-shop equipment consisted of an ancient 18-inch lathe, and a good 28-inch Blaisdell drill with back gear and power feed. I went over to the shop to reconnoiter. I had not been reading the AMERICAN MACHINIST for ten years to no purpose. Back about 1890 I read of a shop that bored a big pulley on a 20-inch drill, by letting the pulley down over the machine, allowing the frame to come up through the pulley between the arms. I saw at once that it was impracticable, if not impossible, to put that pulley over the top of the 28-inch drill with the back gear in the way, so I asked the

chief engineer to have the lag screws taken out of the base, and the machine raised up enough for me to get my hand under it. There were plenty of stout, husky, convict helpers around, and in a few minutes I had my hand under the base, and was gratified to find several cap-screw heads in a circle under the column. Up to this time I did not know how the base was fastened to the column. We then tipped the machine over, took out the cap-screws, and laid the base back in position, first laying down two six by sixes. The pulley was now rolled in and laid down on the base, the prostrate drill was ended up, and on its base between the pulley arms. The cap-screws were replaced, a foot was cut out of the belt, and at 3 o'clock we were reducing the key to chips. At 3.45 the trick was done; at 4.30 the pulley was rolled out on the shop floor; at 4.31 the corners of the key and 3 feet of 3½-inch shaft lay on the floor and we went home to breakfast. Now I *might* have thought of this way of doing the job if I had never read the article referred to, but the fact remains *we did the job.*

CHAS. A. TRASK.

Ball Or Roller Ratchets—Bearing Area.

At page 706, Vol. 28, Part 2, G. C. H. asks for information concerning ball or roller ratchets. In the first place ball ratchets are not so effective as those composed of rollers and I have no hesitation in saying that they can hardly be relied upon. When balls are used a grip can be obtained on them at one point only, but with rollers the whole length is gripped—a feature of great importance. The particulars in this letter will concern roller ratchets only.

To obtain 250 reciprocations per minute is working at high pressure and it takes a very well made ratchet of the roller description to grip without fail at such a high rate, though it can be accomplished if reasonable care is taken. The design shown by G. C. H. is hardly suitable. The outer ring would grip, at the very outside, only four of the rollers, these being the ones which by their own weight, tend to roll down the recess, and, with power applied at the outer ring, cause the wedging action to take place. It should be remembered that this action does not take place so definitely or effectively unless there is some slight pressure on the roller so that it touches the outer ring when the power is applied and the ring turned round in the right direction. The direction in this case would be as shown by the arrow. Therefore the four rollers which would grip would be those on the right hand side; meanwhile the other four would roll back against the side of the recess. While the roller should always be ready for action to prevent a slight movement of the outer ring taking place before the grip proper commences, it is at the same time necessary, in order to allow the outer ring to turn backward or the shaft to rotate forward freely, that there should not be too much weight or pressure on the rollers to retard these actions.

Fig. 1 shows a simple form of ratchet which grips when the outer ring is rotated forward, clockwise, or the shaft backward. It will be seen that the rollers remain in contact with the outer ring so that as soon as the outer ring is rotated forward or the shaft backward the rollers grip immediately, due to this contact. When the outer ring is turned backward or the shaft forward, the rollers revolve, causing a minimum of friction, acting as they do as roller bearings. In this type the roller ring clears the outer one, so that friction is not set up when either one or the other is running free. The bottom line of the recess forms a right angle with a line drawn from the center of the roller to the center of the rachet as in Fig. 2.

Fig. 3 is another type which is decided-

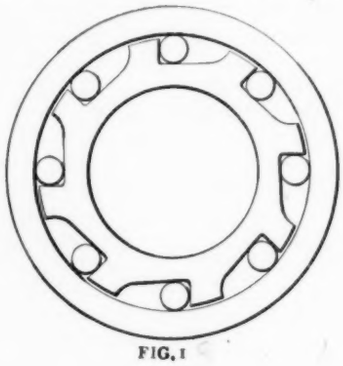


FIG. 1

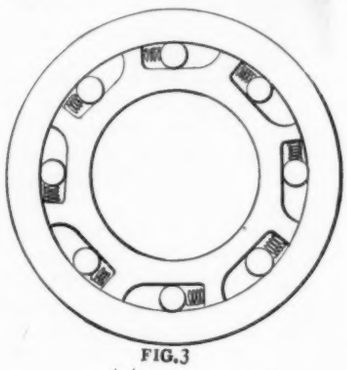


FIG. 3

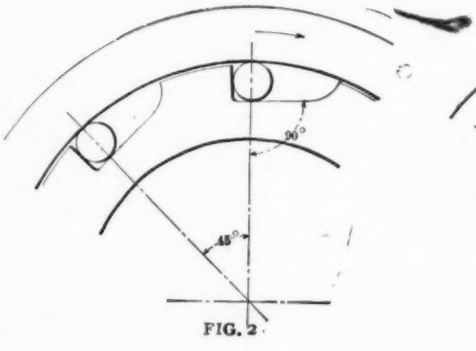


FIG. 2

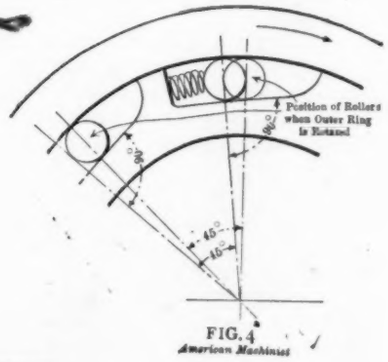


FIG. 4
American Machinist

ROLLER RATCHETS.

ly superior but correspondingly dearer, and if not properly attended to, more liable to get out of order. This also grips when the outer ring is moved forward or the shaft backward, but when running free the outer ring bears against the roller ring, meanwhile compressing the springs by exerting slight pressure on the rollers. The rollers are kept in contact with the outer ring by eight springs which should as nearly as possible fill up the space so that they will have no change to fall out of place. As this type depends solely on the spring, this is an important item to watch. The bottom of the recess at the right hand side of the roller is at right angles to a line drawn from the center of the roller to the center of the ratchet, when the roller is just clear of the outer ring as in Fig. 4, making the distance from the top of the roller ring to the bottom of the recess slightly larger than the diameter of the roller. On the left hand side of the roller the recess is continued by an arc, the center of which is identical with the center of the ratchet; the length being made to suit the spring.

As regards lubrication, the type in Fig. 1 would not be affected, but that in Fig. 2, although requiring lubrication, requires care to be taken that too thick an oil is not used, or the springs will clog, and as before stated, the life of the ratchet is the spring, and if these cannot work easily, the whole action is upset. In any case, such a bearing has to be cleaned occasionally, especially if subjected to extreme cold as suggested by G. C. H. It is of course necessary to harden all the parts, the outer ring, the roller ring and the rollers, otherwise the rollers will wedge too tight and not loosen properly when put into action. But on the other hand if made too hard they are liable to crush.

So much for roller ratchets. There is another thing I wish to say a few words about. It is a point which is very often missed in machine design and reliable information regarding which is very scarce. A draftsman very often laboriously calculates the strength of shafts and works out the proportion of wheels,

and then forgets the most important part, the bearing area of the shaft in the bore of the wheel. It is well known that the wheel cannot embrace any more than half the circumference of the shaft; the bearing area always being taken as the product of the diameter of the shaft and the length of the bearing. This result in square inches divided by the total load or pull on the wheel gives the pressure per square inch of the wheel against the shaft, or bearing area. When a wheel is running on a shaft or a shaft in a bearing and it is well lubricated with oil or grease, the principle of the roller bearing manifests itself. There is a minute film of oil between the shaft and the bearing surface of wheel, and as the wheel rotates it rolls over the oil, provided of course there is not too great a weight on the wheel. This weight or pressure must not exceed 800 to 1,000 lbs. per square inch of bearing area, calculated in the before-mentioned manner.

It is evident that this is a very vital point and the wearing qualities of a machine depend upon it. It also stands to reason that if two metal surfaces slide together under a load, wear is sure to take place, this always happening if the pressure per square inch of bearing area exceeds that as given above, as all the lubricant is forced out. It is admitted that there are some cases where to suit these circumstances would mean exceptionally large bearings, which make an article clumsy looking. In such cases the best job is made by using forced lubrication.

Another thing I have seen draftsmen do is to show an oil recess about half the total length of bearing, presuming they were reducing friction, where if the whole length had been bearing the pressure would have been too high to allow the lubricant to perform its alloted task. I suggest that, as a little more information obtained from practice on this subject would be welcomed by a number of readers, others should tender their views.

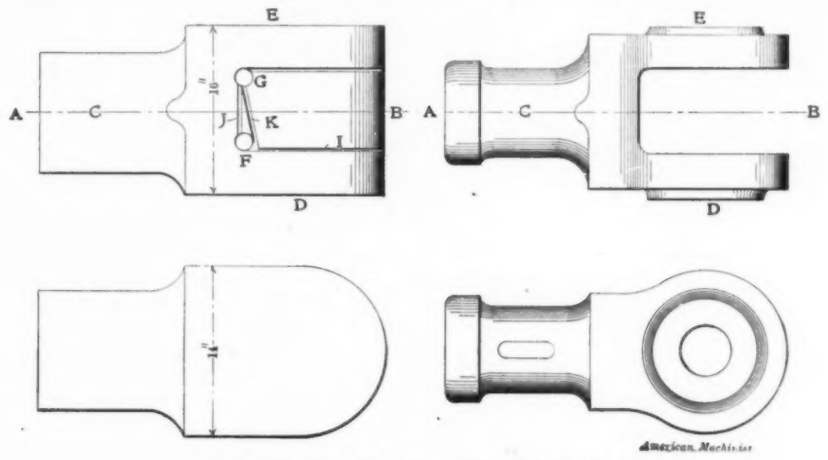
TROCHEE.

B——, England.

Two Methods of Machining Crossheads.

At page 539, Vol. 28, Part 2, I. N. Quire asks how we bored the connecting rod hole when machining the crossheads as described at page 435. Firm No. 1 drilled and bored them on a radial drilling machine, in the sequence stated at page 435, in the following manner:

The planed surface of the crosshead was placed on two parallel packings 4½ inches square by 18 inches long, and clamped down. A 2-inch twist drill was then run through the two sides (each about 4 inches thick). A cutter bar 1⅞ inches diameter was then put in the drill spindle, the bottom end being steadied in a bushing which fits in a 3½-inch hole bored in the center of the table. After the hole had been made large enough a 3½-inch cutter bar was substituted, and the bushing taken out of the table which then received the bar. The hole was then finished by cutters ½x3½ inches section, a very light cut being taken the last time down.



TWO METHODS OF MACHINING CROSSHEADS.

Firm No. 2 proceeded as follows: After the center block had been sawn out, the face *E* or *D* was clamped fast to a lathe faceplate, the latter being suitably balanced. The crosshead was set true to the marking out, and a flat drill 2 inches diameter run through the two sides, the drill being held in the slide rest. The hole was then finished to size with a boring tool. I have seen a large quantity done both ways and they have been quite accurate enough for high class work.

"CORLISS" ENGLAND.

Sketches of Gasolene Engine Parts Wanted.

Will some of the readers of the AMERICAN MACHINIST please send sketch of a *thrust bearing*, also of an *igniter* of the jump-spark type, which is connected direct from the shaft without gears, both of these to be suitable for a 4 H.-P. marine, two-cycle gasolene engine? G. E. L.

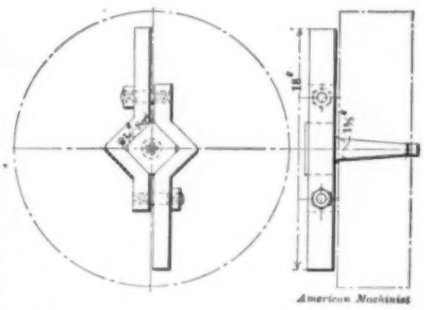
A Device that was a Failure.

Mr. Judd's article, "Making Things Works," at page 738, Vol. 28, Part 2, invites an explanation of my assertion, at page 707, that the device that was a failure, described at page 506, died a natural death for lack of soundness. I really thought that any further comment on the matter would be unnecessary, if Mr. Judd did not disturb the peace of the poor device, trying to make it work, as its failure should be self-evident to any experienced mechanic.

The old mandrel used to turn the pistons and its driver are illustrated by the accompanying sketch. The mandrel was driven into the taper hole of the piston by a well-aimed blow of a copper sledge hammer, and was released in the same way.

With such a substantial mandrel and driver only one roughing cut was necessary at 3-32 inch feed, and one finishing cut at ½ inch feed and at a speed of 30 feet per minute. It is in the performing of this operation that it was thought to save time.

Is there any fair-minded mechanic that will admit that the dog sketched at page 738, fitting at the end of a mandrel 1⅛ inches diameter, would carry four ⅜-inch cuts, at the diameter of 20 inches, with 3-32 inch feed, at 30 feet per minute? The two pins would crush or shear, but if they did not, the twisting stress on the small mandrel and the springing of the dog would cause such a chattering that taking four large cuts with coarse feed would be out of the question, and more than one



THE MANDREL AND DRIVER THAT DID THE WORK.

cut and lighter feed would mean no saving of time over the old method.

What about the finishing cut? If taken with the same four roughing tools, a light feed would be necessary, so that one finishing tool and ½-inch feed are more desirable.

A little more consideration will show that, while in the old way only two blows were necessary to drive and release the mandrel, requiring only a few seconds' time, in the new fixture two nuts had to

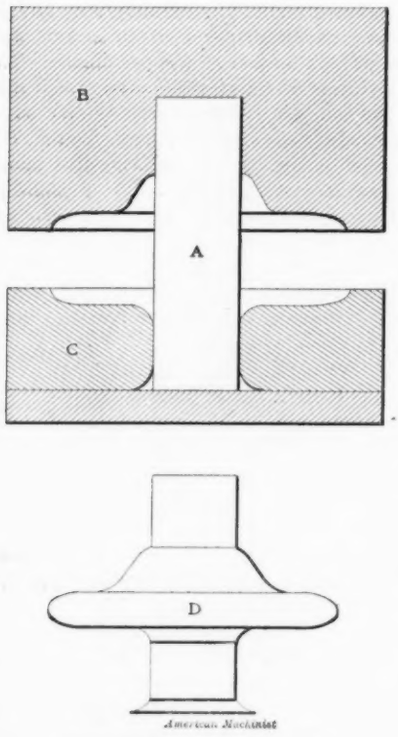
be tightened to secure the pistons, the dog had to be put in place, and, to release the pistons, the dog and the two nuts had to be removed, the central nut had to be screwed back and forth, the very heavy tool-holder and the regular tool-post be put in place and removed, all causing considerable loss of time. Furthermore, while a good blow would drive the old mandrels tightly and securely in place, the two nuts, very probably, would not tighten the pistons enough to prevent them from turning when taking two cuts, and, stopping the lathe to tighten the nuts more, would have caused further loss of time, not to speak of the time that it would take to set the four tools to cut the same diameter, when they had to be removed to be sharpened.

All these drawbacks and difficulties flashed in my mind, as they should to that of others, and the forecast of the failure of the device was not the result of prejudice, but of sound judgment.

J. M. MENEGUS.

Another Interesting Press Job.

I notice at page 852 "An Interesting Press Job" which interested me greatly as I only last week saw a somewhat similar job done in a somewhat like manner. The finished piece is shown at *D*. The



THE WORK AND THE DIE.

first operation is of course to cut the piece of tubing *A* shown in the dies. This piece is seamless brass tube, annealed, about ¾ inch outside diameter and about 3/64 inch thick. The lower die *C* is made in three parts, held in a three-jaw chuck. The die sections are fastened to the jaws and turned to shape. One great difference between the job described by C. F. H. and this is that the upper die in the former is internal, and the one herewith described is external. I think if the lower portion of the upper tool shown by C. F. H. were omitted it would work just as well. The work turned out by this tool is a nice clean looking job. The operation is so simple that it is almost needless to describe it. The piece of tube is placed in the chuck die, the chuck screwed up tight and the upper die brought down. The little outward round at the bottom holds it in the lower die when the upper die lifts up. Another interesting fact about this press, although it does not affect this job, is the fact that it is on a sliding base like a motor. In most shops where they incline their presses they piece their belts out. In this shop the press is moved to make the belt tight and it saves considerable time.

HERMAN JOHNSON.

Should a Machinist Sit While Working?

Re H. T. M.'s contribution, "Should a Workman Sit While Working?" at page 675. I do not think this custom is so unusual in up-to-date shops in this country, and I think many managers and shop foremen allow it. I have been in several shops and have noticed that as long as the workmen have cuts on or their machines are at work those in charge do not seem to object to the workmen sitting.

I have in mind a large concern in Scotland where I paid a visit. They are large manufacturers of power transmission gear. I saw a man lying stretched full length on a board smoking while his cut was going across the face of a large pulley.

I do not say that this was right because I think the men should always keep up a workmanlike appearance, which is impossible when in such a position.

About nine months ago I took over the machine shops of a large concern here and thought I would try the idea. I introduced office stools for the milling machines for a start and I find they are quite satisfactory.

At first the idea was regarded as a great joke by the men and they used sometimes to carry the seats to different parts of the shop, but this only required stopping once or twice. They now appreciate them.

I think it rather hard that a man on a miller should have to stand when he can do his work just as well sitting. All the handles are within his reach and he gets the work done just as well and feels better.

On drill presses it is the same. The only place I think it is not advisable is on lathes where the length of a cut is short and a man has always to be adjusting cuts or where the traverse is so long that he can't follow the carriage. I think here the man would very often rather sit than attend to his lathe when necessary.

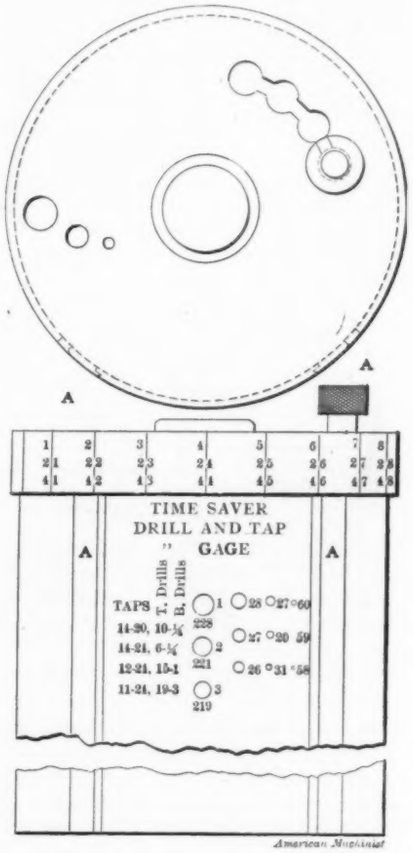
I remember one man—who evidently thought we did not mind what was done—brought in a novel to read while his cut was on. This kind of man requires special treatment. He does not seem to know when a thing becomes ridiculous.

DAVID GARVIE.

England.

A Handy Adjunct to the Morse Drill Case.

The sketch shows a handy combination for machinists and toolmakers. I had a



A HANDY DRILL-HOLDER.

Morse drill case and cut the illustration of Starrett's time-saver drill and tap drill gage out of the catalogue, glued two strips of mahogany *A* on the case and slipped the chart in with a piece of mica over it to keep it clean. It is very handy to refer to when one wants to drill for a tap or if a size is given in decimals for holes to be drilled, as the chart gives the decimal size of drills.

A. C. T.

A Clamp for Jigs, etc.

At page 853, Vol. 28, Part 2, there appears a description of a clamp. The one who wrote the article seems to have taken the design bodily from some in use in our shop. The description of the clamp—

which I devised—is incorrect. The clamp was designed to replace the ordinary hook clamp, retaining the convenience of the hook clamp while doing away with its disadvantages which are:

Small leverage in direction wanted, as when nearly tight the clamping pressure causes friction which prevents the cam surface from sliding further over the pin.

Excessive wear of cam and pin surface.

Weakness of cam hook.

Ability of plain hook clamp to draw two surfaces together even when some dirt remains between, preventing them closing properly.

The action of the clamp is not as stated. The pulling part of the clamp is a toggle pure and simple and not a cam as suggested in the article. The circular slot in *H* is much wider than the projection on the link *G* which moves in it. At no time is the link *G* in sliding contact with the circular slot in *H*.

JOSEPH BIJUR.

A Handy Toolmakers' Vise and Soldering Plate.

Fig. 1 A shows a toolmakers' vise assembled. Its dimensions are 2 13-16 inches long, 1½ inches high and wide. B is the body made of tool steel pack-hardened, ground and lapped all over perfectly square. The slots CC along the sides and ends are used for strapping the vise down on the soldering plate—Fig. 2—to be used on a shaper, drill press, or bolted to the face-plate of a lathe. Inside is milled out as shown, and 19 ratchet teeth are cut having an angle of 30 degrees. Along the center of the base a ¼ inch slot is cut so that the hook screw D will move freely. On top two slots are planed to fit the keys EE. The movable jaw F is likewise made of tool steel, pack hardened, ground, and lapped all over. The jaw is made to rock either way to an angle of 15 degrees. Often a toolmaker has a difficult piece to hold in the vise. It may be parallel one way, but tapered the other, so that it is impossible to hold it in an ordinary vise.

If the jaw is to be held square one way and rock the other way, the two keys GG are put in place and held with the small screw. If the jaw is to be held square the two keys EE are used.

The keys are hardened, ground and lapped so that the movable jaw will come square and parallel. In the front of the movable jaw F is a V slot about 1-16 inch deep to hold round work. In the center a 5-16 inch hole is drilled at an angle of 45 degrees and cupped out to fit the nut H. The hook-screw D is flatted to ¼ inch on the sides to fit freely on the slot in body B. On the back of the screw is fastened a very fine spring .008 inch thick. This bottoms on the sheet plate I and always holds the screw in position up in the ratchets.

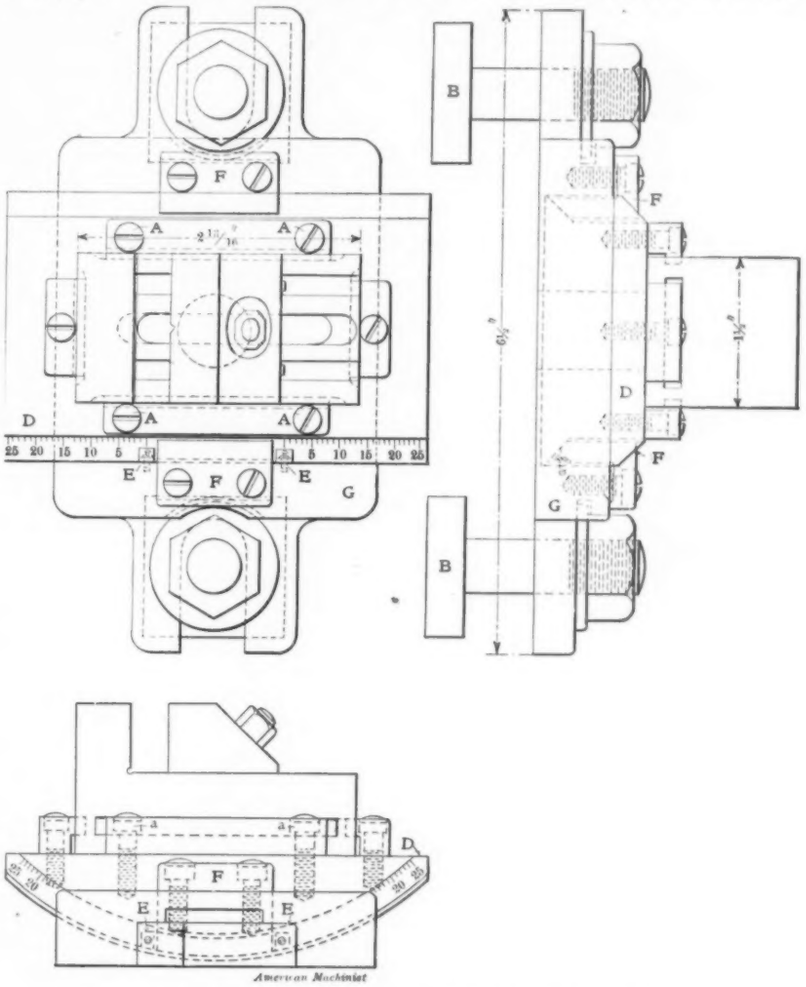


FIG. 2. SOLDERING PLATE WITH VISE ATTACHED.

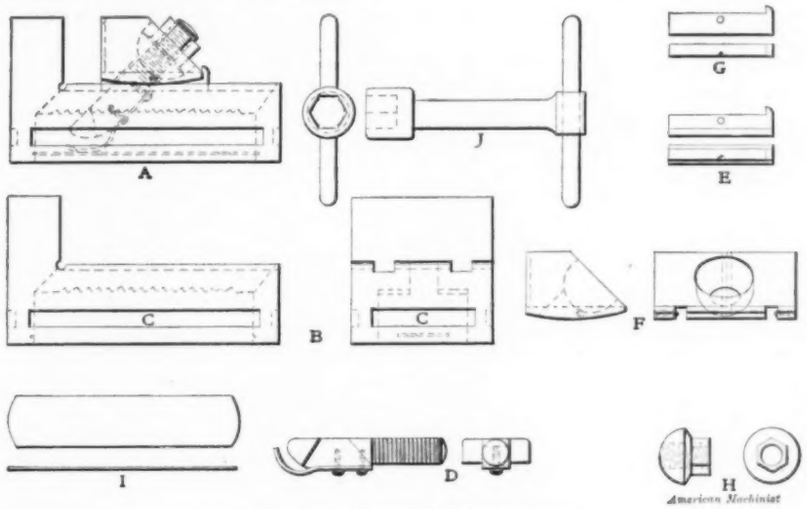


FIG. 1. A TOOLMAKERS' PRECISION VISE.

Sheet-plate I is 1-32 inch thick and is held in position on both ends in a small slot. J is the wrench to tighten the vise with. To move the jaw forward or draw it back press down with the wrench till the hook is out of the ratchet. This allows the vise to be quickly set for size.

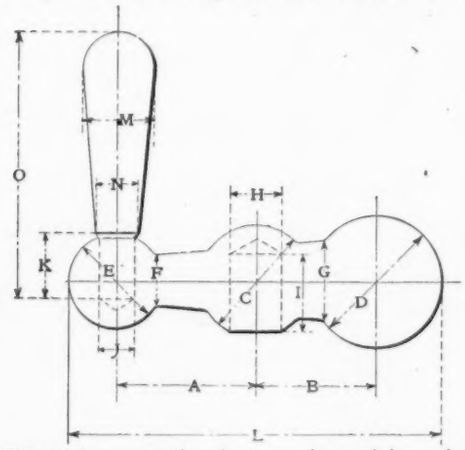
Fig. 2 is a soldering plate. Often we have pieces which it is impossible to clamp on a face-plate. We then solder the work on this plate, which can be swung to any angle up to 25 degrees. It is made to fit any ordinary small face-plate, and has been found very convenient in connection with the vise. The 4 screw holes AAAA are so located that the vise can be clamped either vertically or horizontally on the soldering plate D. The plate G is made of machinery steel, with

a 5/8 inch slot in each end to receive the 1/2 inch bolts BB. A 6 inch T cutter was dropped in the bottom of the lower plate G 11-16 inch deep and 2 5/8 inches wide. This left the bottom concave for the top piece of the plate to slide in, so it can be tilted to an angle of 25 degrees on either side, when a hole at an angle is desired or the piece is to be planed or milled. Two sheet steel pieces EE bent to the right shape are screwed in on the sides to register the degrees. The top piece D when turned in the lathe to fit the bottom plate has a shoulder left on each side with an angle of 45 degrees. The straps FF are made to fit the circle and the angle. When they are screwed down the top piece is held solid to the bottom plate at any angle.

ALMOND.

Machine-Tool Handles.

A large manufacturing concern uses handles with proportions as given in the table herewith. Handles of these dimensions have been tested and found to balance, which is a very desirable feature.



A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1 1/64	7/8	13/16	15/16	21/32	3/8	9/16	3/8	9/16	1/4	15/32	2 11/16	17/32	5/16	1 15/16
1 7/16	1 5/16	1	1 1/8	7/8	1 3/32	9/16	7/16	3/4	5/16	5/8	3 3/4	5/8	3/8	2 7/16
2 5/32	1 31/32	1 1/8	1 5/16	15/16	1/2	11/16	9/16	13/16	5/16	9/16	5 1/4	3/4	13/32	3
2 3/8	2 3/8	1 1/4	1 1/2	1	5/8	3/4	9/16	15/16	5/16	5/8	6 3/4	7/8	7/16	3 1/2
3 13/16	3 9/16	1 3/8	1 5/8	1 1/8	5/8	25/32	9/16	1 1/16	3/8	7/8	8 3/4	15/16	15/32	4
4 11/32	4 1/8	1 9/16	1 3/4	1 5/16	11/16	15/16	11/16	1 3/16	3/8	15/16	10	31/32	17/32	4 5/8

American Machinist

MACHINE-TOOL HANDLE PROPORTIONS.

The table covers the sizes mostly used in ordinary machine work. C. E. J.

A Dredge Bucket Joint.

Referring to the article at page 850, Vol. 28, Part 2, on A Dredge Bucket Joint, I judge from the illustration that it shows the buckets which were built for dredge No. 3 of the Folsom Developing Company of Folsom, Cal., by which concern I was employed for over a year in their repair shop.

The system shown for keying the pins was introduced to do away with the lug pin which has usually to be forged especially for the job, while in this plan straight stock can be used.

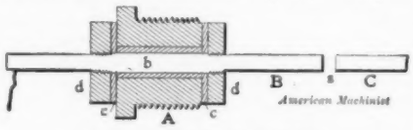
I built over 150 buckets exactly to the dimensions given in your sketch and they were an utter failure, because if a bucket is damaged, the pin has to be removed, and if the key is fitted tight enough to do its work it cannot be gotten out, as it is impossible to get in behind it to drive it out.

The last two dredges Nos. 4 and 5 are fitted with the old style pins as the others did not hold at all.

G. A. HOPPS.

A Gas-Engine Trouble.

What is often one of the most puzzling of difficulties with an explosion engine



MAKE AND BREAK IGNITER.

using the make and break contact method of ignition, and one which seems to have been little dwelt upon in the current literature on this form of motor, is the failure of the insulation of the sparking plug, causing a short circuit, which makes a spark impossible. Such failure may develop from any one of several causes which are quite difficult of detection; and may be only partial, causing failure of the spark only occasionally, or entire. It should be looked for in all cases where it is found that failure of the engine is due to insufficient spark.

If, when the wires are disconnected from the engine, it is possible to get a good spark, while an inadequate one, or none at all, is obtainable when the wires are properly connected, it is generally quite safe to assume that the trouble lies in such defective insulation.

While this insulation is accomplished, by different makers, in manners differing much in minor details, the general principle of all is shown in the accompanying sectional drawing, wherein A is a bronze plug screwing into the cylinder, and B is the pin to which the wire is connected; the other wire being connected to any convenient part of the engine; while the washers, cc, and the part b, are of insulating material, sometimes porcelain or glass, but usually asbestos paper or mica, or a combination of the latter two. C is a part connected with the piston, or with the body of the engine, and making intermittent contact with B; which contact is broken at the proper time to produce the spark.

It will be seen that if the insulation cc, b, is in any way imperfect the current will pass from B into the engine and the circuit will be complete, so that the making and breaking of the contact between B and C will have no effect whatever.

Imperfect combustion, caused by an over supply of fuel, too much cylinder oil or any other cause, may cause a deposit of carbon to collect inside the cylinder, and make connection between the parts A and d, across the washer c; an accumulation of dirt or oil may cause a short circuit at c, or, after long use, the insulation may become burned out and carbon collect in its place. This burning out, of course, cannot occur with glass or porcelain, but in their case breakage is apt to occur, producing the same result.

I have found that, inasmuch as mica is rather brittle and inelastic, and asbestos paper is lacking in firmness, a combination of the two gives the best results. I first make two washers each, of asbestos and mica, and place them alternately at c, then roll asbestos paper to the proper thickness around the pin B, rolling a piece of mica outside, thus getting a polished surface which it is possible to slide very tightly into A; then four more washers of asbestos and mica at c, with the nut d screwed tightly on, complete the job.

W. D. GRAVES.

Preserving Tracings.

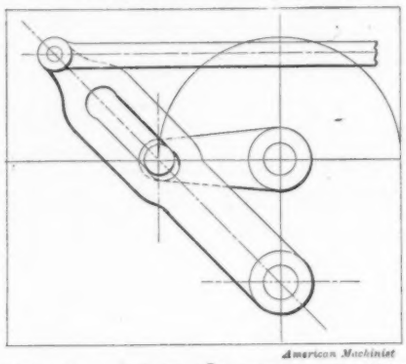
All draftsmen know that few persons not actually engaged in making drawings have a proper respect for tracings. In my experience it frequently happens that shop foremen and others, when gathered in discussion around the board, will carelessly plant a heavy elbow on a nice tracing as it lies on the board, leaving it creased across one corner so that the next time it goes to the printing frame there is difficulty in getting it in good contact with the glass.

I have found it a good plan to round all edges of the board except the left or

working edge to a good radius, say ¾ in. which will leave no crease in a drawing if the visitor leans on one which hangs over the edge of the board. ENG.

Rotating a Shaft 180 Degrees Without Dead Center.

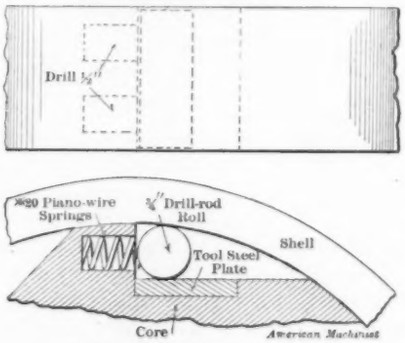
The device illustrated at page 123, current volume, recalls my own struggle with the same problem. The sketch shows the principle of what I used. It is another, though not better, method of accomplishing the result. JAMES BELL.



ROTATING A SHAFT 180 DEGREES WITHOUT DEAD CENTER.

Ball or Roller Ratchets.

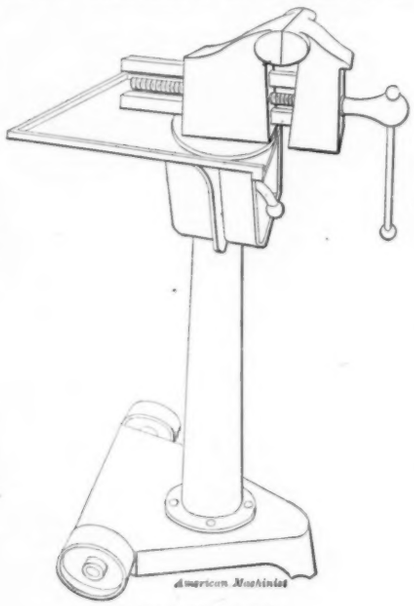
In G. C. H.'s article, at page 706, he asks for information from mechanics who have had experience with ball or roller ratchets. I enclose a print of one I have used for several years. I now have them in use from 2 to 12 inches in diameter. Where there is not much for a clutch to do I do not use springs, but for heavy duty I place two springs, as shown, to make all the rolls work. I have tried many different sizes but found that a ¾-inch roll is as large as will work very well. As the shell wears I re-bore and insert a larger roll, but they never hold as well because the larger the roll the farther the center of the roll is thrown out into the recess, where the shell angle cannot grip the roll. I insert a steel plate that is hardened and the rolls are also hardened. The shell is made of as hard gray iron as can be worked, or lined with a steel ring. I use a light oil to lubricate them. As the steel plates wear I turn them over or pack them up with paper under them to keep the rolls back. The rolls in our large clutches are 2 inches long; I am running small clutches over 300 revolutions with 25 or 30 strokes per minute, and I know of them making over 200 strokes per minute. I would not advise the use of hard grease. O. S. STURTEVANT.



BALL OR ROLLER RATCHETS.

Portable Vise.

The cut herewith clearly shows a convenient arrangement for a vise, particularly adapted to be used in the assembling department on work of a character which requires some hand fitting. As the parts of a machine tool or engine go to the fitter, some will invariably be found that need a touch with a file or other hand-tool, and it can best be done in a vise, and if the fitter must convey the part some distance, as to a bench, the operation must necessarily take more time than if a vise were at hand.



A PORTABLE VISE.

The features involved in the vise shown are not new, but are none the less useful because of that, and while not common are regarded very highly in a number of places both by operators and those in charge. A detailed description is not necessary as the cut shows quite clearly the construction. The base is a plain gray-iron casting, triangular in shape, resting at the rear on two wheels, while at the front it is lowered to touch the floor. From this the column is secured near the center of the casting and surmounted at its upper end with an iron plate provided with a molding on the back and sides to prevent small tools from rolling off.

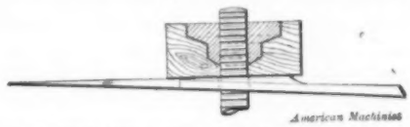
The style of the vise may be any which is preferred, the idea being simply to provide a portable arrangement which can be rapidly moved from place to place as the work may demand.

W. E. WILLIS.

A Babbitt Nut for Bow Instruments.

If Mr. McLeod, who shows at page 782 a mold for making the above-mentioned nut, will put a little oil or vaseline (vaseline is the better) on the screw, the nut will not stick. Also, if he will make the wooden mold like the sketch, making the hole at the bottom a little smaller in diameter than the screw, he will find that it will center itself, as the whole mold can be screwed on the thread of the instrument. The outward pressure of the leg will hold it in place.

HERMAN JONSON.



BABBITT NUT FOR BOW INSTRUMENTS.

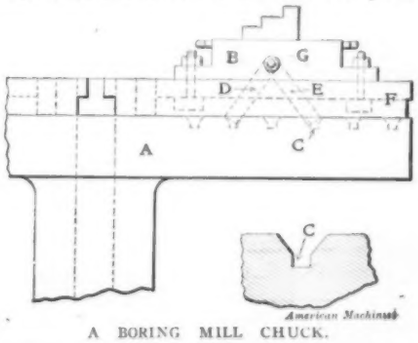
Boring-Mill Chucks.

The regular lathe chuck on a boring and turning mill is very unsatisfactory, as it is difficult to keep the chips and dust out of the screw. If the screw has a coarse thread for quick adjustment, there will be too much strain on the wrench when it is tightened, and the jar and pull of the machine will work loose, and if the screw has a fine thread it takes too long to adjust, also requires much time to remove the jaws from the table, especially on a large mill. The short face-plate jaws that bolt onto the table are the best for quick adjustment, but it is hard to keep them from slipping, especially in heavy work.

The accompanying sketch illustrates a very simple idea for overcoming this difficulty.

The table *A* is turned on the face with a series of concentric V-slots *C*. The false top *F* having T-slots in it, is then securely fitted to it. The face-plate jaws *B* are provided with a pawl in the center, which abuts against the V-slots *C*—for holding on the outside the pawl would be in the position *E*, and for holding on the inside, as shown at *D*. A pin *G*, squared on the end, is secured to the pawl, so that it may be lifted out of engagement with the V-slots. The bottom of the V-slots are made rectangular, so that the end of a pinch bar may get a grip for shifting work while setting it. MORTIMER PARKER.

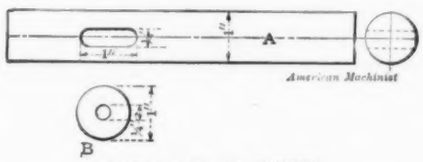
Seattle, Wash.



A BORING MILL CHUCK.

Drilling Holes for a Slot Through a Round Bar.

The sketch shows a scheme for drilling holes through the center of round stock where a slot is required. Suppose you



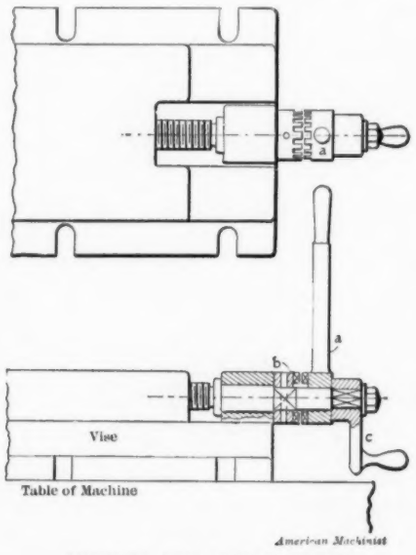
THE BAR TO BE DRILLED.

have a piece *A* one inch in diameter, which requires a slot 1x¼ inch: just turn up a disk like *B* to the same size as *A*, putting a ¼-inch hole in the center, mark where you want the ends of the slot and put *B* in the vise on top of *A* with the edge of the hole on the line scribed for the end of the slot, and proceed to drill.

J. GIBBONS.

An Improved Machine Vise.

The majority of machine vises are provided with a handle which is quite long, and when the vise is bolted lengthwise on the machine table it is very awkward to operate, especially if you wish to open the jaws wide from the closed position,



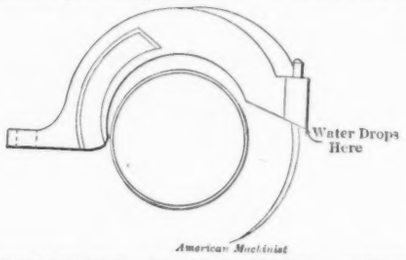
SHOWING VISE IMPROVEMENT.

or *vice versa*, as the handle cannot be turned more than half a revolution before it fouls the table. The enclosed sketch will illustrate a vise which I have had made, and which gets over the difficulty mentioned. The lever *a* is fastened to a toothed clutch, which is loose on the shank of the screw. Another member, *b*, is fitted on a squared part of the shank, and held by a taper pin. For gripping the work, the lever *a* is engaged with the clutch *b*, and the jaws tightened in the usual way. For adjusting the jaws any distance greater than that covered by half a turn of the lever *a*, the clutch is disengaged and the small handle *c* is used. This handle is short enough to turn right around without fouling the table. Another advantage is that the lever can always be so engaged with the clutch that the force applied will act in a downward direction.

B——, England. GRIPPO.

An Improvement in the Grinder-Wheel Guard.

In doing work in the universal grinding machines, I have always been bothered by drops of water falling on the work as I put my micrometer on it to take the measurement, so the other day I decided to obviate the difficulty. Taking off the wheel guard I chipped and filed away about ¼ inch on the left side, leaving the right side that much lower, as shown by the sketch, and after a thorough cleaning inside put the guard back. It works like a



IMPROVEMENT IN THE GRINDER WHEEL GUARD.

charm; each drop that forms on the guard, now runs around to the right side and falls off out of the way.

L. L. LEIGH.

Cutting Off Car Axles.

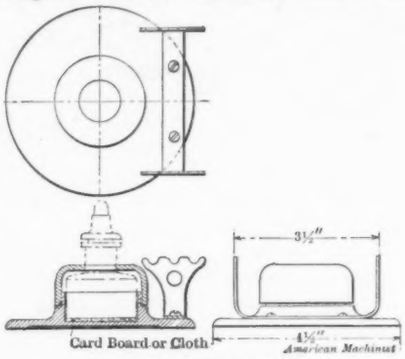
Some time ago I had a number of car axles to cut off. Some were iron and some steel, part of the latter being very hard. The diameters ranged from 4½ to 6½ inches. In order to make reasonable time on the job, something better than the ordinary forged tool was needed, so a rig as follows was got up: A steel washer the proper thickness, a loose fit on the tool post, and as large as could be conveniently used was turned up and a 5/16 inch slot milled across it to a depth sufficient to allow a 5/16 x 1½ inch bar of Novo steel to come level with the lathe center. The washer was used instead of the regular tool post washer, the slot in it bringing the tool the right height and square with the lathe for side clearance. At first I ground the sides of the bar for side clearance but afterward simply had the end upset to about three-eighths wide and ground the clearance on that part.

As well as I remember the time for cutting iron axles was from five to twelve minutes, while some of the hardest steel ones took as much as thirty-five minutes. I think the average time on steel was from twelve to eighteen minutes, which, considering that an ordinary 18-inch lathe was used, seemed like pretty good time.

SCALE.

An Ink-Bottle Holder.

The accompanying sketch shows a very handy ink-bottle and pen-holder and paper weight all in one, with which there is no



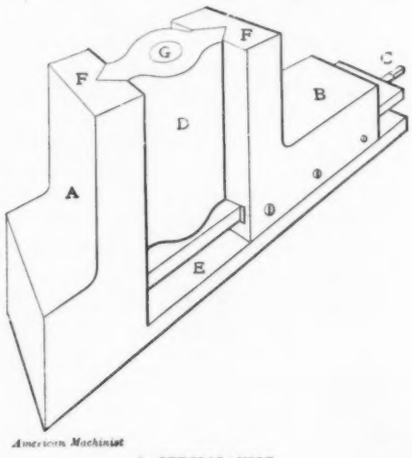
AN INK-BOTTLE HOLDER.

danger of upsetting a bottle of ink, as is often done. The holder is of gray iron and can easily be made by a machinist in a very short time. ARTHUR MCALPIN.

Boring Punch-Press Rams.

In a large shop, where punch presses are turned out in large quantities, the vise shown in the illustration was made to facilitate the boring of the hole in the end of the ram. These rams are gang planed to gage about fifty at a time.

The vise used is not precisely like that shown. The jaw *A* has a certain amount



A SPECIAL VISE.

of adjustment by screw on the slide *E* and means for clamping it securely to *E*. The base *E* has lugs for bolting it to the boring-mill table, and has marks on its ends in line with the V-grooves *F*.

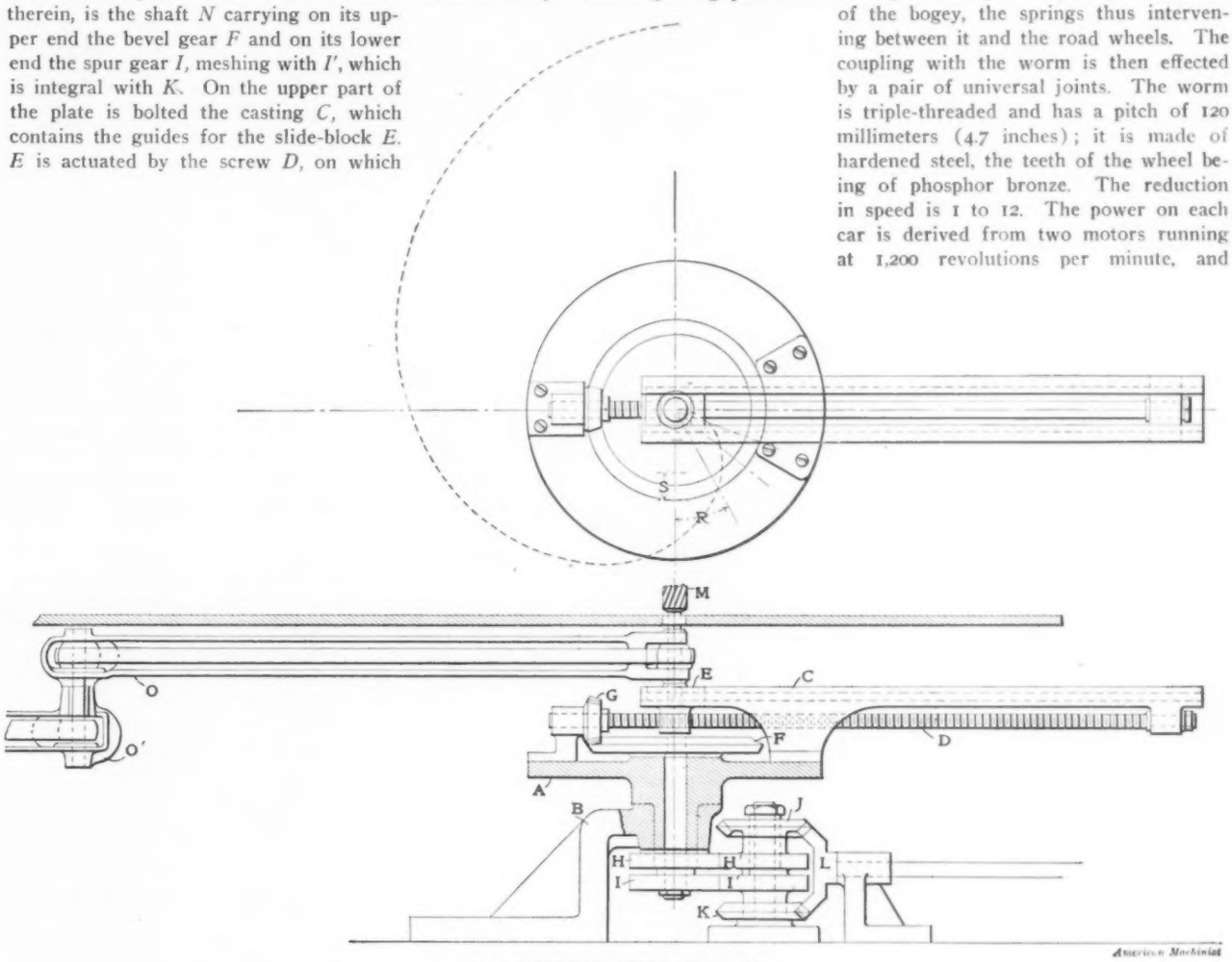
It is used in the following manner: The lines on the base *E* are set with a line running across the diameter of the boring-mill table. A standard ram, with a steel plug fitted in the hole and protruding from it about six inches, is then procured from the tool-room. The plug fits the end of the boring-mill spindle. The jaw *A* is then set to position against the standard ram and secured, the jaw *B* actuated by the screw *C* being used for clamping the ram *D*. It takes less time to set the vise than it does to tell about it.

DIXIE.

An Interesting Epicyclic Train.

The mechanism shown in the illustration was designed to cause a revolving cutter *M* to traverse the path shown by the dotted line.

A is a revolving plate supported in a bearing in the angle block *B*, and having keyed to its lower end the spur gear *H*, which meshes with *H'*, *H'* being integral with the bevel gear *J*. Passing through the center of plate *A*, and free to revolve therein, is the shaft *N* carrying on its upper end the bevel gear *F* and on its lower end the spur gear *I*, meshing with *I'*, which is integral with *K*. On the upper part of the plate is bolted the casting *C*, which contains the guides for the slide-block *E*. *E* is actuated by the screw *D*, on which



AN INTERESTING EPICYCLIC TRAIN.

is keyed pinion *G* driven by *F*. *E* supports the lower end of the shaft of cutter *M*, which is driven by means of a pulley and belt supported by the swinging arms *O* and *O'*.

Let the pitch of the screw *D* and the revolutions of *G* be so related that while *A* revolves through angle *R*, slide *E* will move the length of the division *S*. If *A* continues to revolve through 270 degrees, the cutter will describe the curve shown by the dotted line.

P. S. BUSHNELL.

The first annual meeting of the National Supply and Machinery Dealers Association will be held at the Hotel Chamberlin, Fortress Monroe, Virginia, February 14, 15 and 16. It is expected that a number of subjects of interest to the trade will be brought up for consideration by convention.

Worm Gearing in Electric Tram-cars.*

In order to obtain the maximum power per unit weight of motor the speed of rotation must be high, and the reducing of this to the comparatively low speed of the car-wheels has always presented some little difficulty. Worm gearing possesses the great advantage that a high degree of reduction in speed can be obtained with a single worm and wheel, whereas, if spur gearing, ropes or belts were employed, a multiplicity of moving parts would be inevitable unless the degree of reduction were small. The excessive loss due to friction in worm gears has frequently been spoken of, but with properly designed gearing the efficiency is by no means low. A curve is reproduced to show, *inter alia*, the efficiency of a worm drive operated by an electric motor of 40 horse-power at all loads, from which it is seen that when working at $^1/_3$ load upward the efficiency, which is singularly constant, averages about 90 per cent. The wear in this gearing, after years of work, was found to be inappreciable. Hitherto, when worm gearing has been adopted for tram-cars the motor has been supported directly by the axle, and, owing to the shocks then caused by the unevenness of the road, trouble has frequently been experienced and spur gearing has then sometimes been substituted for the worm. The Oerlikon Company has recently made a new departure by attaching the motor to the framing of the bogey, the springs thus intervening between it and the road wheels. The coupling with the worm is then effected by a pair of universal joints. The worm is triple-threaded and has a pitch of 120 millimeters (4.7 inches); it is made of hardened steel, the teeth of the wheel being of phosphor bronze. The reduction in speed is 1 to 12. The power on each car is derived from two motors running at 1,200 revolutions per minute, and weighing 300 kilograms (660 lbs.) each. If transmission by single spur gear were adopted the motors would run at 500 revolutions per minute, and would weigh each 650 kilograms (1,430 lbs.). Stress is laid on the advantage of having the motor hung from the framing of the bogey, thus avoiding the sudden jars due to the imperfect road.

*By H. Somach, in *Le Génie Civil*: abridged translation from *Abstracts* by the Institution of Civil Engineers.

Keep nuts screwed up tightly, but never screw them tighter than necessary to accomplish the desired results. Cultivate the sense of "feel" in this matter, as it is the only guide. The setting of a nut calls for a nicety of discretion which can be arrived at only by practice and observation and which can never be imparted.—*The Wood-Worker.*

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

505 Pearl Street, New York.

Also Published at 6 Bouverie Street, London, E. C.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist, 505 Pearl Street, New York. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription price $4 per year, postage prepaid, to any post office in North America; $5 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

The AMERICAN MACHINIST CO., LTD., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

No back numbers beyond current year. For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Lieber s and A B C Codes.

During 1905 *the* AMERICAN MACHINIST *printed and circulated* 1,059,100 *copies, an average of* 20,367 *per issue. Of this issue* 19,000 *copies are printed. None sent regularly free. None taken back from newsstands. No back numbers beyond current year.*

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A Valuable Service and Who Pays For It.

The history, up to date, of the development of the manufacture in America of a certain widely used mechanical contrivance seems instructive and interesting, as well as typical of a number of lines of manufacture. In the trade referred to, practically all the manufacturers, except one, are pursuing the old methods. The thing made is analogous to what is known as instrument work; it contains a number of small parts of brass, of german silver and rubber. There is a good deal of soldering, some small gear cutting and the fitting of pivots. etc.; the work ranging all the way from the commonest of its kind to about as fine work as can be done. The method usually pursued has been largely imported from Germany, England and elsewhere. It consists largely of making the parts by hand or by the simplest of tools. The pieces being at times partially turned, let us say, in the lathe, then partially assembled, then returned to the lathe for other operations and so on until the article is completed; the hand lathe, and even the foot-driven hand lathe being largely employed, together with files, primitive drilling machinery, crude, hand-made taps, reamers, etc.; the product being, of course, anything but interchangeable, or made to any fixed or definite system of measurement, English or metric.

The one exception referred to is a manufacturer who employs the most advanced automatic machinery, with the best of tool equipment. He does a very large business, dominates the trade, takes such contracts as he wants, leaving to the other struggling fellows what he does not care for. We happen to know something of how this condition came about, and it is instructive. A missionary for a well-known tool building establishment wandered into this man's shop one day and found him building these little machines by the older plan outlined above. After studying the operations carried on there, devoting a good deal of time to assuring himself that he understood the conditions to be fulfilled and the best method of fulfilling them, he finally, after much persuasion, induced the proprietor to give him an order for a certain automatic screw machine, with tool equipment for turning out a certain specified part of the device manufactured. The results produced by this machine were so astounding to the denizens of that shop that they scarcely knew what to make of them. As soon, however, as they began to understand their significance, they had enterprise enough to begin looking for other work for the machine to do, and were quite ready to go as far as the engineer-missionary-salesman would lead them in putting work onto the machine, and in finally obtaining other similar machines, in order to do as much of the work as possible in that way. The ultimate result was the entire re-equipment of the shop with the most improved machinery and tools, and the manufacture of the device upon the most modern interchangeable plan; the product being not only much better, but so much cheaper as to enable that manufacturer to dominate the business. His competitors probably know little or nothing of the methods by which he attains his results; for some reason we do not quite understand, the engineer-missionary-salesman has not gone to these competitors in an endeavor to supply them with similar machinery, though we suppose it is only a matter of time until he will do so.

Now in this case, this engineer-salesman has devoted a great deal of time to the study of the problem of manufacturing as presented in this particular factory. Being an experienced and skilled man, he has been able to direct things in such a way as to produce the best results; his time is, of course, valuable, but it has never been paid for by the man who has derived the chief benefit from it except as a part of the bills paid for the machine- and other tools supplied by the firm he represents. Just here is the point at which several questions in connection with such work naturally present themselves. The manufacturer does not dream that he is under any obligation to this salesman or to the firm for whom he works. On the contrary he thinks mainly of the amount of money he has paid for tools and considers that the firm and the salesman are under deep obligations to him. He will kick as readily and as vigorously at what he conceives to be an overcharge, or any little failure or defect in machines or tools, as will any other customer, though he owes his business and his prosperity to this concern, and its representative. He has paid no more for the machinery and tools he has bought than would be paid by any large buyer, employing his own experts, and simply ordering what he requires: and it is probable also that even the maker of the machine tools scarcely realizes to the full the nature of the service which has been rendered to himself and his customer by the salesman. Of course, it is clear enough that someone has to pay for the sort of service rendered by this machinery salesman in this case. It is evident that the one who received the chief benefit from that service in this instance did not pay for more than a small fraction of its cost, or of its value to him. It is clear also that other customers of this firm buying similar machines, and which customers employ their own experts, must, by the payment of a price adjusted to cover "selling expenses," bear a large share of the expense of the special expert service rendered to this manufacturer and for which he himself did not pay.

Whether anything could be done which would more equitably distribute the expense of such service, we do not know, but at any rate it is a matter which ought to be better and more generally understood by makers and buyers of machine-tools and may be especially commended to such of them as have given it no thought, as a subject about which some thinking may profitably be done.

Commercial Training at the University of Pennsylvania.

We are informed that the new course in Manufacturing Industry which was established last year by the University of Pennsylvania has met with such encouraging results that an additional advanced course has been established. The following subjects are presented: American Industry, Advanced Accounting, Industrial Management, Transportation, Marketing of Products, Banking, Labor Legislation, Corporation Finance, Business Law, Insurance, Accounting and Economics.

The Telekino.

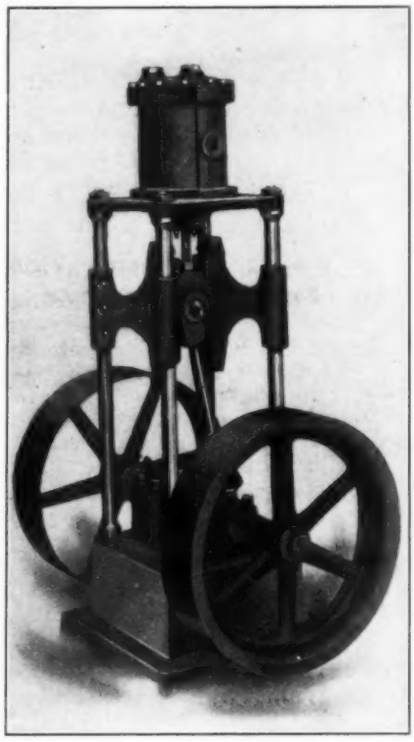
Bernardo Torres Quevedo, a Spanish engineer, has been experimenting with a device he has patented which he calls the "telekino." The device is utilized to control electrical apparatus at a distance by the aid of electric waves sent without wires. Official tests were made at Madrid last month, which are said by a correspondent of the London *Times* to have been successful, the inventor easily controlling from a shore station the movements of a boat out in the bay. The boat used for the experiment carried a battery of accumulators, a motor for driving the propeller, another for the rudder, and two controlling motors for operating the mechanism of the other motors. The controlling motors were directly connected to the telekino, with which they formed one single apparatus. Hertz waves from the transmitting station on shore were received by the telekino. This controlled the controlling motors, which sent currents either to control the rudder motor or the propeller motor so as to govern both the steering and the propulsion of the boat. It is said that Mr. Quevedo controlled all the movements of the boat without the least difficulty.—*Western Electrician.*

Celluloid, made from cellulose and camphor, is a very good electrical insulator, but it has the very grave defect of being very inflammable. *La Revue Pratique de l'Electricite* states that MM. Mabille and Leclerc have discovered a method of rendering it incombustible. They dissolve the celluloid in a mixture of ether and alcohol, and incorporate in the solution a certain quantity of a salt of iron, ferric chlorid or some other. They then evaporate the solvent and the celluloid obtained is perfectly incombustible.

New Tools and Machine Shop Appliances.

BELT-DRIVEN AIR-COMPRESSOR.

We illustrate herewith a small air-compressor designed for such purposes as air is used for in machine-shops, boiler shops, etc.



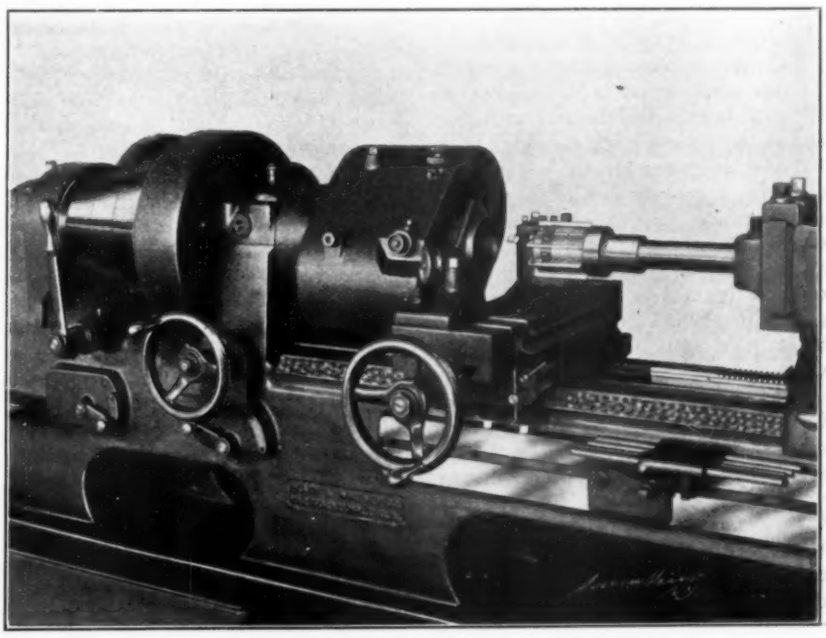
BELT-DRIVEN AIR-COMPRESSOR.

It occupies small space and is belt-driven. The general design of the machine will be clear from the engraving, and it is necessary to say, only, that the discharge valve is a hardened steel ball, and the inlet valve is a common beveled-seat valve made in a cage and held in place by a cap plug, so that it can be removed by simply taking out the plug.

The piston rings are claimed to be practically frictionless. They are turned to the size of the bore of the cylinder, and then cut into three or more sections, with lap-joints, and are held against the wall of the cylinder by small coiled springs. This compressor is made by C. F. Fulmer, Plainfield, N. J.

TURRET LATHE EQUIPPED FOR MACHINING SMALL GASOLENE ENGINE CYLINDERS.

The accompanying half-tone shows a Pratt & Whitney 3x36-inch turret lathe with special equipment for finishing the interior and ends of cylinders for small gasolene engines. The machine is without the usual rod feed, and in place of the regular chuck is fitted with a special chuck which grips the cylinder by means of two swinging clamps, each operating against two fixed points. These clamps have also two bearing pins in a swinging member, consequently the work is supported at eight separate points while being machined, and the necessity for clamping so tight as to distort the casting is thus avoided. The boring bars in the turret are fitted with high speed cutting tools, and on the shank of one of the bars there is an arm holding a cutter for turning the collar at the end of the cylinder. The reamer is allowed to float on its shank and is of the expansion type. As both turret and cross slides have independent power feeds, the cross slide tools are in action simultaneously with those in the turret. The cylinder shown has a bore 4 in. diameter, 7 in. deep.



TURRET LATHE EQUIPPED FOR MACHINING SMALL CYLINDERS.

The Taxation of Alcohol Used in The Industries.

In the January number of *Moody's Magazine*, Charles E. Keator has an article which effectively presents the arguments on the question "Why Industrial Alcohol should be Untaxed."

The main points of the article are indicated in the following summary: The United States is the only country that taxes alcohol used in the arts, which is the most important material in hundreds of industries; untaxed alcohol would revolutionize chemical and other manufacturing industries; it would also greatly benefit farmers and workers; Alcohol is better and cheaper than kerosene for light; it is safer and cheaper than gasolene for fuel for heating, for cooking and for motor engines in automobiles, cars, boats, etc.; there are many reasons why denaturized alcohol should be untaxed, and none why the tax should be retained.

Mr. Keator has the following to say with reference to the use of alcohol in internal combustion engines: "The use of the internal combustion engines for running all kinds of farm machinery, pumping, etc., is rapidly increasing, and this type of engine is destined to be adopted on millions of farms, thus creating an immense demand for motor fuel. The increased demand for fuel for these engines, added to that of the motor vehicles and power boats which have come into such general use during the past six or eight years, has already had the effect of doubling the price of gasolene, the supply of which is limited, and decreasing in proportion to the demand. It is therefore absolutely necessary that some new fuel supply should be secured, and so far as is known, alcohol is the only satisfactory substitute. With the tax removed there is no reason why alcohol should not be generally used for motor fuel purposes."

The hope is expressed that Congress will take some action in this matter, the following facts with reference to legislation on the subject being presented:

"The wide-spread benefits which would follow the enactment of a law relieving from taxation this important industrial material are so manifest that it is surprising that Congress has not long ago taken action on this subject. The ostensible reason for the failure of Congress to act is the fear that some reduction in the public revenues would result. This belief is, however, without foundation. A law providing for untaxed, denaturized alcohol would have little or no effect on the revenues. Owing to the excessive tax of $2.07 per gallon on commercial alcohol, untaxed substitutes, chiefly wood alcohol, have taken the place of grain alcohol, and the only revenue now derived is from the ethyl alcohol used in the manufacture of articles in which denaturized alcohol could not be used. The manufacturers of these articles would continue to use taxed pure alcohol, and the Government would receive as much revenue from that source as it does now. In this connection it is important to note that in all the foreign countries referred to above, in which no tax is imposed on denaturized alcohol, the need for revenue is more urgent than in the United States. Alcohol is regarded by these countries as a material as properly exempt from internal revenue taxation as pig iron or other domestic raw materials, and the advantages to their manufacturing and farming industries of their liberal alcohol policies are held to far outweigh the benefit of any revenue they might possibly secure."

Echoes from the Oil Country—Visiting a New York Machine Shop.

The world is full of surprises for the man who wanders far enough away from home to get into New York City. I am not entirely sure why my friend should direct me to the place he did. As another friend said,"He is somewhat of a joker," and perhaps besides the very interesting things which he knew that I would see at the machine shop he thought it would be interesting for me to see the location of the shop. Be that as it may I was duly armed with a card which was to introduce me to Mr. Warman, of the Keller Mechanical Engraving Co., and the location was 570 W. Broadway.

While not exactly "from Missouri" I find that New York is somewhat larger than any city in the oil country. When two men of intelligence and sobriety can make a mistake of one hundred streets in getting off the cars or returning over a route which they have traveled only a few hours before you may know that there are lots of streets besides the hundred.

I know that Broadway twists around some, and it seemed perfectly natural for it to be called W. Broadway at some point where it took a shoot in that direction. I began looking for it when I was up town a few miles.

I cannot be very definite in my statements as to locations, directions, or distances as my usual standards of measurements for those things did not seem to apply.

I began to inquire and was told to take the elevated and go down town; that it was down there somewhere. I thought it was in the other direction and the vagueness of the "somewhere" made me think my informant might be mistaken, and I tried another one. This man was quite precise.

"Go down on the elevated to Bleecker street." I went. When I got off and inquired I found that I was on W. Broadway. It was a different one from the Broadway that I knew. It lacked the crowds. It also looked as though it did not much care what others thought of its looks. It was evidently out on dress parade, but still it was not the sort of place where I would naturally look for a machine shop. At 570 there was not the sign of an old casting lying around the door anywhere so far as I could see, either on the outside or the inside. The door was open but there was nothing in the hall to see; just a narrow dirty hall with a solid door at the end of it. There was a room at one side that looked as though the building was going to be torn down and they had begun on it. Perhaps they begin at the bottom to tear a building down in these parts. I wouldn't be a bit surprised if they did, but where is that machine shop I am looking for? I don't see a sign, or anything else for that matter that seems to indicate that there is any business of any kind or descripion going on in the place.

Perhaps I have been too fast in coming to conclusions. I look at that card again: "Keller Mechanical Engraving Co."

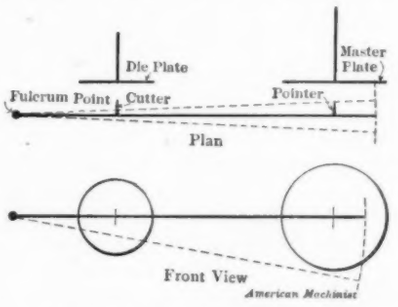


FIG. 1. DIAGRAM OF MECHANICAL ENGRAVING MACHINE.

What is there about that to suggest a machine shop. That might be some mechanic in a little room on the top floor of almost anywhere. I didn't ask about it but the mechanical part of it might mean that he is making engravings of lathes and calipers and other things. I am a little confused about the matter, but surely in some way the idea did get into my head that there was a machine shop. I don't recall a thing that was said to make me think so but I do think it.

While these thoughts have been running through my head I have been wandering (and wondering) back and forth through the hall and out onto the street, and looking up toward the top of the building and along the street to see if I could discover some signs that might lead to the discovery of the shop that I was in search of. Perhaps the man who is standing looking at a dray can help. No, he never heard of the place, but by some sense of the native he does know that there is an elevator, and shows me a door that conceals it, and just now along comes another man who wants to get up in the world and who knows where the lift is, for he rushes in and pushes on the same button that I have just ceased pressing.

In course of time that elevator boy lands me up an unknown distance and indicates to me the direction I should go,

and there, in plain sight is a sign on a door and it tells me that here at last is the sought-for establishment. I don't know how they attract their trade, and I don't know how a man who wants to find a machine shop in a hurry "to get a little job done" goes about it.

As soon as I got inside I began to feel more at home. I found Mr. Warman to be a gentleman and a mechanic. He first took me into the shop where he is constructing some new machines. I am not going to try to describe these machines. In the first place I do not know enough about them to do them justice, and in the second place Mr. Warman is entirely competent to do it himself. The one that interested me the most was the one that does the engraving. In this machine a large bronze plate is held and revolved. This plate has on it the same design that is to be on the finished die. On the frame of the machine is another head that can be moved to or from the first one. This head has a chuck that revolves in unison with the plate that is secured to the spindle of the first head. If a piece of steel is caught in the chuck and the machine started, the bronze plate and the piece of steel revolve alike regardless of the distance they may be apart.

A bar, one end of which is made a fulcrum from which the other end is free to be moved back and forth and up and down, is so placed as to extend by both heads, the spindles of which run at right angle to the bar. At the outer end of the bar is a pointer that can be made to touch on the bronze plate. I judged the center of this pointer to be on the same vertical plane as the spindle of the head that carries the master plate. A cutter head is arranged to slide on the bar, and whatever the position of the die head the point of the cutter can be made to be in the same vertical plane as the center of its spindle. When the pointer is raised to the center of the master plate the cutter in the cutter head is the same height as the center of the die head. Means are also provided whereby the cutter can be moved endwise so as to be fed into the piece of steel held in the chuck in the die head. The cutter is driven by a very nice little rope drive (perhaps it should be called a *string* drive) and the head is so arranged that there is no side pull on the cutter spindle. The diagram Fig 1, may help to make this description somewhat clearer.

It will be at once seen that any movement back or forth of the pointer which is produced by swinging the end of the bar will produce the same kind of a movement of the cutter, and the same thing is true of any motion up and down. While the motion of the cutter will be alike in kind, it will differ in degree just to the extent that it is nearer to the fulcrum than the pointer is. Now, if the cutter is made to touch the steel that is held in the chuck in front of it, and is able to cut away anything that it touches, and the point of the pointer is made to follow over a form on the master plate, there will be produced on the steel a form like the one on the master plate. Its size will, of course, depend on its distance from the fulcrum.

To get an exact reproduction of the master plate several things are necessary. Among others may be mentioned the setting of the cutter, and a very important point is the size of the cutter. It must be of the same shape as the pointer, and must bear the same relation in size to the pointer as the master plate bears to the plate to be cut. With a master plate of perhaps a foot diameter and a die block of, it may be, two inches, and a pointer small enough to follow into the fine lines it can be seen that it is necessary only to have the pointer travel over every part of the master plate; and to have the die plate move in unison with the master plate; and to have the cutter of the right shape and able to cut where it touches, and a die will be produced that is a miniature of the master plate.

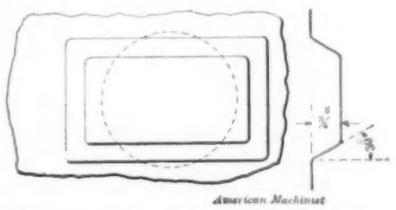


FIG. 2. SHAPE OF PLATE BEING REPRODUCED.

After seeing how it is done, and seeing it being done, it may all seem simple enough. After it is thought over a while it begins to have the appearance of not being so very simple after all. The bar that carries the pointer and the cutter-head has to be reasonably heavy so as to have sufficient rigidity, and while it is counterbalanced it still takes some force to move it back and forth, but this has to be done with little enough force so that the pressure of the pointer will not mar the form, or master plate. The end of the pointer has to be fed down so as to travel across the plate from the center outward, and this feed should be variable, being faster for a roughing than for a finishing cut, and faster for work when the die plate is nearer to the fulcrum than when it is far away. Means must be provided to move the die plate in unison with the master plate no matter where it is.

The cutter head must be made very accurately to produce accurate work, it must be capable of being run at a high rate of speed for hours, and its drive must be flexible enough to reach it at any point on the bar to which it may be moved.

On the new machine now being constructed Mr. Warman is making extended use of electricity to simplify some of these points, and appearances would seem to indicate that he will produce quite a difference in the efficiency and the looks by so doing.

On second thought I have concluded that it would not do that establishment much good to put out a big sign at the foot of the stairs, and the upper stories have some advantages in the way of light and air that are being taken advantage of. I have thought that to make those bronze plates they must have some kind of a foundry. I would not now be a bit surprised to find that it is on the roof, or at least up in the attic.

The master plate that was on one machine that was at work was an oblong one, like Fig. 2, and the design was down on the bottom, which was about three-quarters of an inch below the surface. The sides surrounding this design were about thirty degrees from perpendicular. The dotted circle shows the part of the plate that the pointer was traveling over. I was surprised to see the ease with which the pointer traveled up the sharp incline. Had someone designing such a motion asked what angle it was safe to assume would be possible, I should certainly have said that one was much too steep, but Mr. Warman informed me that he had done work successfully where the sides were only six degrees from perpendicular. *After* seeing what he was doing, and the ease with which he seemed to be doing it. I was ready to believe almost anything. I should not be surprised now to know that he was making that pointer climb up sides that were undercut. I think he would find a way to do it if he thought it had to be done.

I hope this poor and brief description of his machine will tempt Mr. Warman to give us a good description of it and of his very interesting establishment.

W. OSBORNE.

Engineers in Siam Organize.

We have received No. 1 of Vol. 1 of *Siam Engineering*, the journal of the Engineering Society of Siam. This issue contains 35 pages (printed in English). It is published in Bangkok. An account is given of the Engineering Society, also a list of its officers and members, the latter containing 84 names, an uncommon collection of nationalities. We quote the following from an editorial on the formation of the society. "It was felt that residence abroad, apart from the great centers of engineering industry, tended to a falling behind the times, to a 'rusting' which the engineer can afford less than any other professional man. It is a matter of experience that, when an engineer who has been so placed, returns home, it often takes him many weeks or months of hard study to recover the lost ground."

Judging from the contents of the journal, the automobile must be becoming an important factor in Siamese transportation. The greater part of the reading matter relates to a project for a mo-

tor-road between Bangkok and Penang, about 700 miles. We learn that considerable trouble is experienced in that hot country with the pneumatic tire, and that the use of solid tires is recommended by some.

The Grand Trunk Railway to Use Electric Locomotives, under the St. Clair River.

The claims to superiority of single-phase motors for electric traction over direct current motors become stronger, the greater the distance over which the electric power is to be distributed. One of the arguments in favor of their adoption by the New York, New Haven & Hartford Railroad is that the system employed in the terminal operation will be the same as would eventually be used over long stretches of the railroad; however, it now appears that motors of this same type are to be given a chance to demonstrate their efficiency in a service of quite a different character, namely, the hauling of heavy trains, freight as well as passenger, through a tunnel, a service very similar to what has for several years been performed in the B. & O. R. R. tunnel at Baltimore by direct current locomotives. The tunnel in question is that under the St. Clair river which connects the American and Canadian divisions of the Grand Trunk Railway, terminating at Port Huron, Mich., and Sarnia, Ont. The length of the tunnel is 6,032 feet and the whole distance to be electrically equipped will be 19,348 feet. The smoke and noxious fumes from steam locomotives in this tunnel had become exceedingly inconvenient and dangerous, and the matter of using electric locomotives has been under consideration for some time, resulting in the Westinghouse Electric & Manufacturing Company receiving the contract for the complete equipment to enable this to be done. The alternating current delivered to the locomotives will be single-phase, 25 cycles, with a potential of 3,000 volts. Each locomotive unit will weigh about 62 tons, being carried on six 62-inch drivers, driven by three 250 horse-power single-phase series-wound motors, and having, of course, the speed control by variation of the potential in the secondary from the transformer. Six of these locomotive units have been ordered, and they can be coupled together and operated on the multiple-unit plan. They are to be capable of exerting a draw-bar pull of 25,000 pounds on a 2 per cent. grade at a speed of 10 miles per hour.

The Niles-Bement-Pond Company have issued through their engineering bureau a little pamphlet entitiled "Foundations and Setting Machine Tools." This tells how to prepare the foundation for heavy machine tools. It is of course based upon wide experience and ought to be very useful to those who have occasion to direct the preparation of such foundations.

On Friday evening January 5, occurred the second annual banquet tendered by The Whitman & Barnes Mfg. Co., Chicago, to the foremen in the various departments of their West Pullman factory. All the foremen (19 in number) were present, together with the factory manager A. D. Armitage and the superintendent, D. M. Motherwell. A most enjoyable evening was spent and plans for increasing the capacity and new methods of handling work were discussed freely. The banquet was held at the Vendome Hotel, Chicago.

An exhibition of the work of the twenty-second class of the Baron De Hirsch Trade School, 222 East 64th St., New York, will be given Tuesday evening, January 30 from 7 to 10 o'clock.

Personal.

F. B. Davant, formerly general superintendent of the Glover Locomotive & Machine Works, Marietta, Ga., has opened an office at 703 Prudential Building, Atlanta, Ga., for the general practice of mechanical engineering.

J. W. Carrel, who retired from the presidency of The Draper Machine Tool Company, of Worcester, Mass., when that company was purchased by The Whitcomb-Blaisdell Machine Tool Company, has connected himself with Hill, Clarke & Co. of Boston, and will represent them in Connecticut. Mr. Carrel is well known in the machine-tool trade, was formerly with Hill, Clarke & Co., and will travel in his old territory.

Frederick R. Slater, late assistant to the electrical engineer of the Interborough Rapid Transit Company, of New York, has opened an office at 100 Broadway, New York, for the practice of electrical engineering. Mr. Slater had much to do with the installation of the electrical equipment of the New York Subway and previous to this undertaking had been engaged in installing the third rail system on the New York elevated railways.

Obituary.

Edward Cline, for the past thirty years foreman at the J. H. Dialogue shipyard, Camden, N. J., died recently at his home in that city, aged sixty-eight years.

J. Frank Seavy, Jr., died January 15, at St. Luke's Hospital, Allentown, Pa., of pneumonia, aged forty. He was assistant chief mechanical engineer at the Bethlehem Steel Works. He was a graduate of the Massachusetts Institute of Technology.

George W. Hey, a patent lawyer of Utica, N. Y., died there January 15 of the effects of a stroke of paralysis which he suffered while arguing a case in the United States Court in Utica. He was an inventor of note, having contrived the cancelling machine in use in the post offices of the country.

Andrew A Scott, for the past fifteen years foreman of the Ludlow Valve Works, Troy, N. Y., died January 15, after an illness of several months. Mr. Scott was forty-eight years of age. He was born in Dundas, Canada, and entered the employ of the Ludlow Company twenty-seven years ago.

Jesse Boynton, formerly a well-known iron builder, died in Newport January 18. Mr. Boynton was at one time prominently identified with bridge building, having constructed one of the Mississippi river bridges and a large number in the South. He was formerly president of the Columbian Iron Works at Baltimore.

Henry C. Fish of the H. C. Fish Machine Works, Worcester, Mass., died at his home in that city January 15, eighty-one years old. He was born in Marlboro, Vt., went to Worcester at the age of sixteen, learned the blacksmith trade, the trade of his great-grandfather, grandfather, father and five brothers, and at the age of nineteen started in the blacksmith business for himself. In 1887 Mr. Fish was a prominent member of the L. W. Pond Machine Company, which was reorganized as a stock company. In 1889 he disposed of his stock in the company and gave his attention to his machine works. He leaves a widow, two daughters and one son, the latter, E. H. Fish, being an instructor at the Worcester Polytechnic Institute and a well known contributor to our columns.

Business Items.

The National Acme Manufacturing Company, Cleveland, Ohio, to more satisfactorily serve their constantly increasing trade in the Middle and Northwestern States, has decided to open a warehonse in Chicago at an early date, where a complete stock of Set and Cap Screws and kindred goods will be carried.

The Dayton Pneumatic Tool Co., Dayton, Ohio, manufacturers of the "Green" Pneumatic Hammer, report their business for 1905 as having been most satisfactory. Notwithstanding the fact that there is a tendency toward the end of the year to delay purchases until after the beginning of the new year, an unusually large number of orders was received in December. The company has recently ordered additional machinery for its Dayton works, which will increase their capacity to about 300 hammers per month.

The business of B. M. Jones & Co., Boston, Mass., has just been incorporated under the Massachusetts laws. The officers of the new corporation are: President, Benjamin M. Jones, Boston; vice-president and general manager, James A. Warren, Chicago; second vice-president, Richard L. Thomas, New York; secretary and treasurer, Walter J. Klein, Boston. The company has affices at 141 Milk street, Boston, and 143 Liberty street, New York. The company will act as the sole representative in the United States, Canada and Mexico of Samuel Osborn & Co., Clyde Steel & Iron Works, Sheffield, England, manufacturers of Mushet's Steels, including Mushet "Special," "High Speed," "Titanic" Steels, also Mushet High Speed Twist Drills and Cutter Blanks, and also in the same capacity for the same territory for Taylor Bros. & Co., Limited, Clarence Iron Works, Leeds, England, manufacturers of "Taylor" Best Yorkshire Iron, for staybolts, axles, piston rods, crank pins, etc.

Manufacturers.

The Laurel (Miss.) Cotton Mills, will double its capacity.

The Shelby (Ohio) Stove Company's plant was burned. Loss $15,000.

The Berneville, (Pa.) Foundry & Machine Company will move to Topton, Pa.

The Union Steam Pump Company, Battle Creek., Mich., will enlarge its plant.

The Celluloid Starch Company, New Haven, Conn., is putting up a new $13,000 factory.

R. Hoe & Company, printing press manufacturers, New York, will build a new factory.

The Waterbury, Conn., Clock Company has broken ground for a new wing to its factory.

Plans are being drawn for a new factory for the Geometric Drill Company, New Haven, Conn.

The Montford Machine Casting Company, Baltimore, Md., will erect an addition to its plant.

Armour & Company, Chicago, Ills., will erect a $100,000 canning plant at Fort Worth, Texas.

The Garlock Packing Company, Palmyra, N. Y., will establish a branch factory in New Orleans, La.

The Kiechler Manufacturing Company, Cincinnati, Ohio, cornice works, etc., will erect a new factory.

The North Shore Electric Company, of Evanston, Ill., will erect a $500,000 plant at Waukegan, Ill.

The Donaldson Iron Company will build a new foundry at Emaus, Pa., to employ 150 additional hands.

The Available Hard Fibre Company, Rochester, N. Y., wil build an extension and add new machinery.

The American Lead Pencil Company has accepted plans for a new five-story factory at Hoboken, N. J.

The handle shop of the Oliver Ames & Sons, North Easton, Mass., was burned. Loss over $30,000.

J. N. Brause and Geo. W. Sharadin, will erect an artificial ice plant to cost about $15,000 at Kutztown, Pa.

The Detrick & Harvey Machine Company, Baltimore, Md., will build an addition to its plant to cost about $10,000.

The Commercial Club, of Rapid City, S. D., is negotiating with some Cresco, Ia., parties for a sash and door factory.

The Works of the Carnegie Steel Company at Greenville, Pa., were destroyed by fire, entailing a loss of over $400,000..

It is stated that W. T. Carlton, William Gettis and others, are soon to erect a $250,000 cotton mill in Lattimore, N. C.

The Consumers' Electric Company, New Orleans, La., is completing arrangements for the erection of a $40,000 power house.

The Barrett Manufacturing Company of Beloit, Wis., will erect a $200,000 plant in Peoria, Ill., for making roofing paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat free. E. B. Smith, Columbia, Pa.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O Chase, Newark, N. J.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear and Machine Co., 141 Oxford st., Philadelphia.

Wanted correspondence with large established manufacturing concern in the market for a profitable business. Box 51, AMERICAN MACHINIST.

Fine machinery, tools and dies built to order; experimental work a specialty. Northwestern Machine & Tool Co., 614 Union Trust Bldg., Detroit, Mich.

Andorn and Martin, Engineers, Automatic machinery. Factory and power plant requirements. Detail drawings. 25 West 15th St., Phone Chelsea 3696.

Wanted—To rent or purchase a small machine shop in the Eastern States suitable for manufacturing light machines. Answer, giving terms. Box 363, Montrose, Pa.

Wanted—To build special machinery, jigs, fixtures, punches, dies, power press tools and machine work. Accurate work guaranteed. Chas. S. Dexter, Attleboro, Mass.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted.—Good live agents all over country to sell our make of cranes; also all classes of tramways; we erect complete; those having established trade desired. Yeo Bros., Philadelphia, Pa.

Wanted—Second hand milling machine automatic feed; bed must extend 20 inches in front of head; must be in good condition. Mention make of machine when replying. Box 25, AMERICAN MACHINIST.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

For Sale.

For Sale—One No. 1 Bardons & Oliver screw machine, nearly new. Brown Machine Co., Ltd., Battle Creek, Mich.

For Sale—Small machine shop, in thriving N. E. village. Good opening for man with small capital. Box 26, AMERICAN MACHINIST.

For Sale—10-ton crane, 40 ft. span, rope drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co. Burlington, Iowa.

For Sale—Gas engine business with engines from two to sixty horse power capacity. Stock of finished and unfinished engines and patterns, drawings, etc. Will sell at a bargain. Apply Box 55, AMERICAN MACHINIST.

For Sale—One No. 7 Landis Tool Grinder with automatic gear feed. Swings 20", 72" between centres. 18" wheel, 1½" face. In first-class condition. Has been very little used. The Tabor Mfg. Co, 18th & Hamilton Sts., Philadelphia, Pa.

For Sale.—Entire plant of Philadelphia's best known Tamashanta Mill; machinery in perfect order and ready to operate; bankrupt sale; machinery, good will and office furniture will be sold at a sacrifice; immediate possession can be given. Edward M. Bernstein, Attorney, 299 Broadway, New York city.

For Sale.—Well established machinery manufacturing business. Patented machinery; well established with the trade. Competition very limited. Market very large in U. S. and foreign countries. Good profits. Opportunity to acquire paying business. Investigation and correspondence invited. Address H. R. Irwin, Sta. "B," Cincinnati, Ohio.

Business Opportunities.

Good estimater wanted for old structural and ornamental iron works company. Must invest. Attractive salary to right man. Box 66. AMERICAN MACHINIST.

High-grade manager desired by engine manufacturing company. Must buy interest. High standing. Good earnings. Net solid assets, $75,000. Also will entertain good mechanical engineer who will invest. Box 67. AMERICAN MACHINIST.

Machine shop for sale. Here is a great opportunity for someone who wants a business of his own. This is modern plant, located in central New York. Main buildings 100x60 ft., two stories, equipped with about 50 high-grade machine tools, including lathes, milling machines, shapers, drills, etc. Plant is adapted for automobile or any high-grade work, and is now running. This plant and business cost more than $50,000, and we can sell it for less than $12,000, if taken promptly. This price includes, patents, jigs and tools for making a very profitable specialty. To the right parties we can make very favorable terms. William A. Reade & Co., 402 Chamber of Commerce Bldg., Cleveland, Ohio.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Visible typewriting expert, 34; now holding responsible position; competent in all branches of the business; designer, inventor; wants to make a change. Box 70. AM. MACHINIST.

Wanted.—Position as assistant to the master-mechanic in some large manufacturing plant, to qualify myself for similar place. Am first-class machinist, fair eduction, working knowledge of elecricity, and am at present master-mechanic on small plant. All replies considered. A. Ellsworth, Box 69. AM MACH.

Situation Wanted.—As superintendent of hardware factory, by young man 33, with 17 years' experience in manufacture of light hardware, in brass, bronze, iron and steel, cast and wrought metals; interchangeable system. Experienced metal pattern maker, mechanical draftsman and designer, with inventive and executive ability, and the "get-along-with-everybody" disposition. Address "Bona-fide," Box 72, care AM. MACHINIST.

ILLINOIS.

Electrical and mechanical engineer desires change; technical graduate, seven years' experience. Specialty; Motor Drive. Box 68, AMERICAN MACHINIST.

Wanted—By March 1. Position as superintendent or general foreman, by thoroughly up-to-date man; 15 years' practical experience; best of references. Box 73. AM. MACH.

Situation Wanted—Responsible, by party at present engaged as chief draftsman and mechanical engineer with machinery building concern; age 30; college graduate, with considerable shop and drafting room experience; position where energy, judgment, and inventive ability are required. Salary $2,000. 1-3 months notice if possible. Box 65, AMERICAN MACHINIST.

NEW JERSEY.

Draftsman, 33, A1, mechanical, desires position; shop preferred. Box 44, AM. MACH.

Mechanical draftsman technical, desires to change position. Box 59, AMERICAN MACHINIST.

Draughtsman, expert in mining machinery, desires position. Location no object. Box 42, AMERICAN MACHINIST.

Experienced pattern foreman of good executive ability, at present employed desires to make a change. Practical and up-to-date on all kinds of work. Box 61, AMERICAN MACHINIST.

NEW YORK.

Purchasing Agent, well-posted on local conditions, foundries, forges, etc., mechanical and electrical experience. Box 74. AM. MACH.

General foreman, 36, successful in handling men and work to best advantage, varied experience in high grade machinery. Expert machinist. Box 23, AMERICAN MACHINIST.

Position as chief draughtsman or designer by man of wide experience in design of special machinery, all kinds of press work and tools for interchangeable manufacture. Box 75. AMERICAN MACHINIST.

An American, 32 years old, M. E. and technical graduate, 10 years' practical experience, 4 years as superintendent, open for engagement Feb. 1. Salary $3,000. Box 80. AMERICAN MACHINIST.

Designer, graduate M. E. age 30; shop 2 years, 9 years office, special and small machinery, apparatus, jigs, fixtures and experimental work; practical and inventive man; hustler; location immaterial. Box 82. AM. MACH.

Master Mechanic, chief engineer or first class executive position; thoroughly understand engines, boilers, dynamos, manufacturing machinery, etc. Assume full responsibility; first class mechanical engineer. A1 references. Box 50, AMERICAN MACHINIST.

Salesman, 15 years' experience, practical mechanic, having sold American machinery and tools in Europe, Africa and in this country, wants to represent a firm for New York or abroad. Best references. Address J. 45, AMERICAN MACHINIST.

Superintendent; hustling, aggressive, economical, will raise plant to highest point of efficiency; proficient in speeding help, organizing facilities and producing highest grade of work at lowest cost; expert at tools, dies, fixtures, drafting, accurate estimator and rate fixer; past record will convince before closing. Box 83. AMERICAN MACHINIST.

Wanted.—A position as mechanical engineer or superintendent of manufacturing company, who are in need of improvement in their machinery or methods of manufacture. Am an expert in steam engineering and in devising labor-saving methods. The particular forte of the writer is in the line of manufacturing extracts of all kinds; dye wood, tanning extracts, etc. Am conversant with all methods of extraction and concentration of liquids by evaporation under vacuum. Economical generation and application of steam for all purposes. Thirty years in last position as superintendent. Would be pleased to have interview with parties who are desirous of reducing their manufacturing expenses. Address James McBride, M. E., 146 Kent st., Brooklyn, N. Y. Member of A. S. M. E.

OHIO.

A technical graduate with 6 years' experience in gasoline engine, agricultural and seeding machinery, in a good position, wants to better himself. Box 49, AMERICAN MACHINIST.

Wanted—Position as finishing foreman in brass shop where plumbing or steam goods are manufactured. Am up-to-date, thoroughly experienced and have references as a sober and honest man. Box 47, AMERICAN MACHINIST.

PENNSYLVANIA.

Mechanical engineer, general mill work, wishes to change. Box 32, AMERICAN MACHINIST.

Position as master mechanic or superintendent of construction by practical man after March 1. Box 18, AMERICAN MACHINIST.

Experienced die maker on drop forge, combination, automatic, sheet metal, etc., dies, wishes position in Philadelphia. Reference Address Box 46, AMERICAN MACHINIST.

Position wanted by A1 accountant and office manager. Thorough knowledge of costs and general office work in manufacturing business. Box 24, AMERICAN MACHINIST.

Designing draftsman wishes to change; technical graduate, 8 years' experience on gas engines and automobiles; practical and inventive man. Box 76. AM MACHINIST.

Situation wanted by a first-class designing draftsman. Technical graduate, 15 years' experience in general machinery design to shop cost. A1 references. Address Box 39, AMERICAN MACHINIST.

Architectural and civil engineer, with extensive experience in the design of industrial buildings is open for engagement with large manufacturer or with a mechanical engineer making a specialty of such work. Box 81. AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Several die makers, also tool makers for fixtures and gage work. Ross Rifle Co., Quebec, Canada.

Wanted.—Two competent draftsmen thoroughly experienced in design of coal handling machinery. State education, experience and salary required.—Box 63, AMERICAN MACHINIST.

Wanted—A mechanical engineer thoroughly experienced in design, repair, and maintenance of bridge shop machinery. Shop has capacity of 18,000 tons per annum. State age, education, experience and salary required. Box 64. AMERICAN MACHINIST.

CONNECTICUT.

Wanted—Foreman for a machine shop employing 20 hands, making small varied parts. Knowledge of drawing and estimating essential. State age, experience and wages wanted. Married man preferred. Address Box 48. AMERICAN MACHINIST.

ILLINOIS.

Wanted—Die Sinkers good wages; steady work. Box 52. AMERICAN MACHINIST.

Draftsman—We have positions now open for draftsmen. Call or address Western Electric Co., Chicago, Ill.

Wanted—Draftsmen—Men accustomed to interchangeable work on small tools, jigs and fixtures. Western Electric Company, Chicago, Ill.

Wanted—Designer thoroughly experienced in the design of small, accurate, automatic machinery, and with ability to design and develop such machinery. With young growing concern. Excellent opportunity for right man. In replying state age, experience and references, also state salary wanted. Box 53, AMERICAN MACHINIST.

Wanted—An assistant superintendent for shops in machinery line, experienced particularly in gas engines and steam pumps; familiar with best machine tool work, piece work practice, etc. Growing position for man of ability and energy. Give references, experience, salary expected, etc. Box 20, AMERICAN MACHINIST.

MARYLAND.

Wanted—To meet our constantly increasing requirements, we invite applications from first class toolmakers, machinists, Jones & Lamson operators, Gisholt machine operators, milling machines, bench hands and pattern makers. Address Box 6P, AMERICAN MACHINIST.

MASSACHUSETTS.

Machinists Wanted—We are increasing our force and need good all-round men for the building of special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

MICHIGAN.

Wanted—A first-class outside erector, experienced on electric traveling crane work. Must be able to take full charge of the job and show results. Box 58. AMERICAN MACHINIST.

Wanted—3 or 4 first-class, A1 automatic screw machine hands; to experienced men will guarantee steady position and highest rate of wages. Answer, with reference, to Box 85, Detroit, Mich.

Wanted—Experienced mechanical draughtsman with technical training on automobile work, in one of the largest Michigan factories. Only college graduates with experience need apply. State particulars fully and wages expected. Address Box 28, AMERICAN MACHINIST.

MISSOURI.

Wanted—Superintendent for a Missouri gas engine factory employing 50 hands. No foundry. Sizes made from 2 to 50 H. P. Good salary. Do not apply unless able to handle entire mechanical duties. An experienced executive wanted. No designing or changes. If found satisfactory, some stock for sale guaranteed to earn 25% per annum. Box 62, AMERICAN MACHINIST.

NEW JERSEY.

Wanted—A first-class mechanical draftsman; state experience and salary wanted. Box 881. AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

NEW YORK.

Wanted—Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

Mechanics—Several for small accurate brass and steel work. State experience and wages. Box 4. AMERICAN MACHINIST.

Wanted.—Two or three first-class lathe hands; also one vertical milling machine man. Steady work and highest wages to good men. Box 77. AMERICAN MACHINIST.

Toolmakers wanted on die work in typewriter factory. Only those experienced on fine, accurate work need apply. Address Box 79, AMERICAN MACHINIST.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 859, AMERICAN MACHINIST.

Wanted—Experienced draftsmen, first-class machinists, toolmakers and gage makers; give detailed experience, references, age and wages expected. Remington Arms Company, Ilion, N. Y.

Foreman wanted for tool room of typewriter factory. Must be experienced tool designer and accustomed to handle men. In writing state experience and wages desired. Address Box 78. AMERICAN MACHINIST.

Wanted—Strictly first-class foreman for steel car plant. Must have all-around ability of mechanic. Not over 35 years of age; familiar with keeping costs, controlling men and a hustler. Box 54, AMERICAN MACHINIST.

Wanted—Factory stores clerk; must be energetic and familiar with all supplies and materials used in the manufacture of firearms; give detailed experience, age, references and salary expected. Remington Arms Company, Ilion, N. Y.

Wanted—Foreman for small shop; must be experienced in manufacture of small duplicate machinery and accustomed to handle men. State age, experience, salary expected and references. Address BB, 56 AMERICAN MACHINIST.

Wanted.—By large manufacturing concern, competent man to take charge of inspection of small interchangeable parts. Must have practical shop experience. (Fire-arms preferred.) Give experience in detail, age, references and salary expected. Box 71. AM. *M.*

Wanted—Man with technical training as draftsman and engineer, with experience in the design of special machine tools for economical production of interchangeable machine parts in large quantity; person with practical experience as a machinist preferred. Box 953. AMERICAN MACHINIST

Wanted—For immediate service, a bright young designing mechanic to travel and to devise ways and means to adjust a machine to conditions in cotton mills. Must be bright, gentlemanly and capable. Good salary and advancement for right man. Warp Twisting-in Machine Co., 309 Broadway, New York.

Wanted—Man of practical experience in the manufacture of small, interchangeable parts; gun work preferred; qualified to estimate on piece prices; must have good executive ability and judgment; state experience and salary expected. Box 926, AMERICAN MACHINIST.

Wanted—An expert machinist and experienced salesman combined to represent a well known manufacturer in Ohio and Indiana. Must understand thoroughly cutting tools. Tool making experience desirable. State age, experience, salary expected at the start. Box 17, AMERICAN MACNINIST.

PENNSYLVANIA.

Wanted.—High-grade erecting machinists for air compressor work.—The Blaidsdell Machinery Co., Bradford, Pa.

Wanted—High-class machinists and toolmakers. Good wages. No labor troubles. Box 41, AMERICAN MACHINIST.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMERICAN MACHINIST.

Wanted—Fitters, machine hands and erectors on Corliss Engine work. Scottdale Foundry & Machine Co., Scottdale, Pa.

Wanted—Expert toolmaker, tools for rapid reproduction brass, malleable & steel duplicate parts. State experience, etc. Address H. N. C. Box 57, AMERICAN MACHINIST.

Wanted—A number of A1 tool, die and instrument makers. Also wood pattern makers. Address Employment Department, Westinghouse Electric & Manufacturing Co., East Pittsburg, Pa.

Draftsman, who is a competent engineer with experience on jig and tool work and heavy sheet metal stamping and forming dies is wanted by a large Philadelphia concern. Write stating age, experience, references and salary wanted. Address Box 60, AMERICAN MACHINIST.

Wanted—A competent engineer to act as assistant to General Manager of a large corporation manufacturing a large line of cast iron specialties and to take charge of the construction and creative department of the business. He must have some experience in designing and operating labor saving appliances in the iron foundry line, and know how to handle men and machinery. A liberal salary will be paid to the right party. Applicant must not be over middle age, must be energetic and undersand both the theory and practice of iron founding and machine shop work. Address giving age, previous experience and salary expected. "Capable." AMERICAN MACHINIST.

WISCONSIN.

To meet our constantly increasing requirements, we invite applications from first-class machinists and bench hands. Those familiar with engine work preferred. Address with references Globe Iron Works Company, Menomonie, Wisconsin.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen, with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.